Mechanical World —— November 1958

STEEL BAROMETER

IF steel output this year does not reach 20 million tons it will compare badly with the mounting capacity of the industry which is now well above the 23 million ton mark. The continuing expansion of steel usuage to which we have become accustomed in recent years has been set back roughly this year; not that steel usage could be expected to go on increasing for ever—that would be impossible—but a gradual approach to stability would have been a better reward for the wholly praiseworthy work of building up capacity with a steadily increasing productive efficiency.

Steel production is on so large a scale that any but gentle fluctuations are not welcome. The stock position should be the reservoir for regulating the effects of change, absorbing and feeding the margin first one way and then the other. This pattern alters with the economic climate and has nothing of the regularity enjoyed by some continuous processes which enables stocks to be accumulated ready for delivery against a seasonal selling period. Steel for the most part is dispersed in merchants' and consumers' stocks, and when the demand for products manufactured from steel diminishes, then forward buying ceases while the stocks are being run down, to a point which matches the level of activity, then buying recovers to match this level.

Steel is a most versatile material which serves an immense field. There is a certain degree of safety in this, but not an absolute one for steel plants have become increasingly specialized and one particular section of the industry can be hard hit while another is fully occupied. There are contrasts like that at present—between the heavy and light sections—regulated by such things as the difference between shipbuilding and motor car manufacture. Steel output is one of the industrial barometers and it cannot be regarded as anything but unsettled at the moment.

PLANT PROGRESS

PLANT and machinery of any kind has a useful life depending upon the circumstances within which it is used and how it compares with the new equipment with which it could be replaced. The rule in this is the total annual cost and how it stands in relation to possible improvements obtainable from new equipment.

There are extremes of contrast within the gamut of industrial processes. In one instance, a continuous chemical process operating on a small scale because of a strictly limited local supply of raw material still prospers with a truly ancient plant for the simple reason that the smallest possible modern plant would be idle most of the time and eating its head off. Indeed, if a similar source of supply were considered to-day it would be discarded as not worth bothering about. As it is, since the plant is there and it pays, it keeps going.

Similarly, in most general engineering shops there is the odd machine or two which are invaluable for certain occasional jobs, but they are infrequently employed. They have been there so long and have been so little used that they cost next to nothing to run and do a good job. The only time they fail is in making something which can be bought from a modern specialized machine working all the time at the one job; but for the work they do in that particular shop they could not be replaced by any modern machine without putting up the cost.

These examples are the exception, however, and serve to emphasize the rule, which is that a works or factory depends very largely on a main body of machinery or plant being fully employed on maximum output, so that the unit cost of production is as low as possible consistent with all the required properties being secured in the finished product. It is here that developments have to be watched very carefully for if an innovation is allowed to slip by it will be no time at all before the product is at an economic disadvantage in the market. Not only has the unit cost to be known all the time, but its components have to be kept in mind, particularly capital investment and running cost. A machine when it is newly installed has a known expectation of life and its annual cost is calculated on this basis. At any time, however, it might be superseded by an improved design and the opportunity for making cost comparison must not be lost in case there is profit to be gained.

Actual practice in this matter varies. In some factories it is continuous, in others it is periodic and more of a wholesale shake-up. Whichever method is adopted, it is important not to get behind. The relevant information, which alone makes improvement possible, should be collected all the time.

LOG SHEET

Earthmoving at Biggest Opencast Site

There is an ever-increasing demand for earthmoving machines to shift coal with speed and economy for opencast mining. The largest opencast coal undertaking operated by the National Coal Board in Britain—and one of the most extensive in Europe—is the Radar North site at Widdrington, on the Northumberland coast, which will eventually cover an area of 1000 acres.

Working on this massive site is a large concentration of Caterpillar earthmoving equipment operated by Derek Crouch (Contractors) Limited, of Peterborough, Lincolnshire, who were awarded the 12–15 year coal winning contract 14 months ago, when they were already engaged in opencast work in the area. Crouch bought a fleet of 14 Caterpillar DW21–Athey PR21 dump wagon units to work in conjunction with a seven-yard Lima 2400 dragline powered by a Caterpillar D397 engine and a Ruston-Bucyrus six-yard face shovel for overburden excavation. In just over ten months, these machines, together with a 7800 Marion dragline, have worked night and day to shift 11,000,000 cu yd of overburden of an estimated 150,000,000 cu yd total. One of the machines in the earthmoving team, a Caterpillar Series 14A D8 crawler tractor, has logged 6200 hours since the operation started, or 20–20½ hours a day at full throttle. It is customary for a D8 to run up 10,000 service hours in three years but at its current rate of progress, the Crouch D8 at Radar North may well reach that figure in a third of the time.

The site yields a high grade coal with ash content varying from 10% to as little as 5%. On an average, 8000–9000 tons per week are being cut from the seams.

There are coal seams at five levels of the box cutting which is being worked at present and mining has now reached the second of these seams. The first seam, of a depth of 50 ft, has now been cleared. The second now being exposed at the seaward end of the cut is 80 ft deep and 2 ft 6 in. thick. The further three seams are at 140 ft, 190 ft and 230 ft and vary in thickness from 3 ft to 6 ft 6 in.

Beneath the topsoil is a 30–70 ft bed of heavy clay banded with layers of running sand and gravel. Below this lie beds of hard sandstone rock and shale and the coal seam.

Sea/Fresh Water Plant

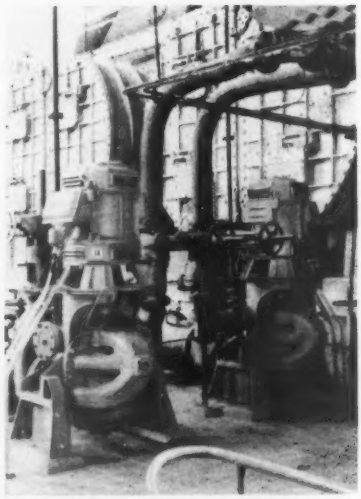
An interesting example of the subject examined in an article in our August issue on "Fresh Water from the Sea", comes from Guernsey where the water board have ordered the first sea-water evaporating and distilling plant for commercial operation in a country with an adequate rainfall. The economy of Guernsey depends upon sufficient fresh water supplies for its fruit and flower industries, and the new Weir plant will ensure these supplies even if drought conditions prevail locally. The installation will produce half a million gallons of fresh water daily from the sea, and in making use of the Weir Multiflash method the Guernsey authorities have found that it will prove cheaper than building reservoirs and catchment areas to collect rain. This is because the design of the plant allows very high rates of fresh water production per unit of heat input for much lower capital cost than was previously possible. This new method of producing fresh water is an important fundamental development, even for countries with an ample rainfall, as in addition to considerably reducing capital outlay, it can also be designed to combine the economic production of electricity and "soft" water for industry as well as domestic supplies. There can be a shortage of drinking water even in countries with a plentiful rain supply. The nature of the ground surface may be such that collecting methods are impracticable and the rain runs to waste, or, it may run into fast flowing turbulent rivers carrying so much solid matter in suspension that it is quite unsuitable for drinking or for industry without considerable capital expenditure for filtering plant or settling tanks.

The Guernsey plant will be supplied by the Glasgow engineers G. & J. Weir Limited, who have already supplied plant producing three-quarters of the world's total output of fresh water from sea-water, and it will be completed and commissioned early in 1960. It will take the form of a fabricated mild steel structure, 70 ft long, 19 ft wide and 19 ft high, internally divided into various flash and preheater sections. A de-aerator unit will reduce to a minimum the causes of corrosion by removing gases dissolved in the incoming sea-water, and chemical treatment of the sea-water will prevent scale formation on the internal surfaces of the plant to allow continuous operation at maximum output.

South Denes Power Station

At the new South Denes power station of the C.E.G.B., there are two Metropolitan-Vickers generating units each with a maximum continuous rating of 60 MW, running at 3000 rpm and operating with steam conditions of 900 psig, 900° F at the turbine stop valve.

Each turbine is a two-cylinder machine, with the high-pressure and low-pressure rotors rigidly coupled and supported by three spherically-seated main bearings. The bearing at the high-pressure inlet end is combined with a Michell thrust block. The cylinder casings are provided with annular steam belts at the extraction points, enabling steam to be withdrawn from the complete periphery, instead of from localized areas, thus preserving thermal balance. At 60 MW M.C.R. the final feed water temperature is 385° F.



Extraction pumps at the South Denes power station, Great Yarmouth. The driving motors are Metropolitan-Vickers squirrel-cage type RS

The high-pressure rotor is machined from a one-piece ½% molybdenum steel forging with 19 integral discs

carrying single rows of stainless steel impulse blading. The double-flow low-pressure rotor, with six stages of stainless steel single impulse blading in each flow, has separately forged and machined Hykro wheels shrunk on and keyed to the Hykro spindle.

Steam is admitted to the high-pressure cylinder from two steam chests situated one each side of that cylinder. Each chest carries an emergency stop valve and a governor valve. The emergency stop valves are operated automatically by duplicate emergency overspeed governors on the turbine spindle, set to operate at 3300 rpm. In addition, the emergency valves may also be tripped instantly by hand.

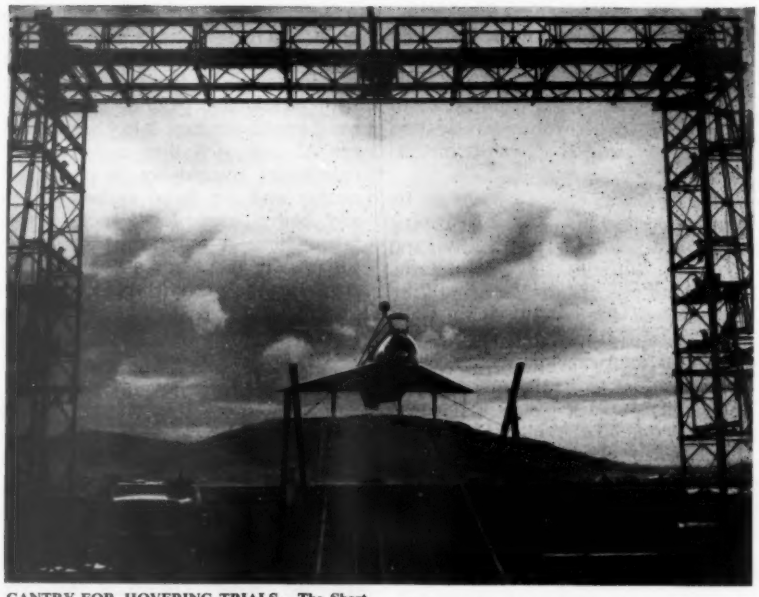
Turbine speed fluctuations are controlled by a centrifugal governor which operates the governor valves through an oil relay system, while hand and motor-operated speeder gear permits the raising or lowering of the turbine speed up to 5% above or below normal while the set is running.

At 60 MW M.C.R. steam exhausts from the low-pressure casing at a vacuum of 28·9 in. Hg to twin condensers of Vickers Armstrongs manufacture.

A comprehensive supervisory control system is installed, with complete indicating and recording equipment, providing the turbine operator with all necessary information about axial expansion, running clearances and degree of eccentricity of the rotor.

The steam turbines are direct-coupled to hydrogen-cooled generators of standard Metropolitan-Vickers design. Each machine employs a hydrogen pressure of 15 psig and supplies 3-phase 50-cycle alternating current at 11·8 kV, 0·8 power factor. Voltage regulating equipment is of the Metropolitan-Vickers VSA type.

Boiler feed pump motors, of which four are installed and a further four are on order, are of the Metropolitan-Vickers type HTAS, 1400 hp, 2960 rpm, drip-proof pattern. In the type HTAS construction, a double inlet system of cooling air circulation is employed. A propeller type fan is fitted at each end of the rotor core, and when the motor is running cold air is drawn into the machine at both ends. The air is then directed over the end-windings and through axial ducts in the stator core and finally discharged through a large aperture in the top of the yoke frame. (This type of motor is supplied with drip-proof enclosure or alternatively as a totally-enclosed, closed-air-circuit machine with water-cooled air-coolers).



GANTRY FOR HOVERING TRIALS.—The Short SC.1 VTOL research aircraft hovering in the test gantry at Belfast. The cable system in no way supports or assists the aircraft, but provides a three-dimensional envelope of freedom for hovering. The posts at the front and rear of the gantry are visual aids for the pilot

Extraction pumps are driven by four Metropolitan-Vickers type RS 105-hp squirrel-cage motors, and other motors for pump drive include twelve KN-B and GK squirrel-cage motors from 1-5 hp to 150-hp.

Eastern Region Diesel-electrics

The type 1-800 hp main-line diesel-electric locomotives, ten of which are on order from the North British Locomotive Company Limited, for service in the Eastern Region, are intended for freight train working in the London area, including inter-regional services to Hither Green and New Cross Gate, and parcels trains between Liverpool Street and Southend.

Numbered D.8400–D.8409, they were designed, and are being constructed to the requirements of the British Transport Commission under the general direction of Messrs. R. C. Bond and S. B. Warder (Chief Mechanical Engineer and Chief Electrical Engineer respectively of the British Railways Central Staff, B.T.C.), the detailed design and supervision of construction being the responsibility of Mr. K. J. Cook (Chief Mechanical and Electrical Engineer, Eastern and North Eastern Regions).

The diesel engine in the locomotives is the Paxman pressure-charged 16 cylinder V-type 16 YHXL. Running at the governed speed of 1250 rpm, the power output is set at 800 bhp with a specific fuel consumption of 0·375 lb per bhp-hr.

The main generator is a G.E.C. self-ventilated type WT 881 d.c. machine with a continuous rating of 505 kW 1700 A 290 V at 1250 rpm.

The driver's cab is fitted with fully duplicated driver's desk, with controls and gauges for driving in either direction. Straight air braking is used on the locomotives, but equipment for the vacuum brake operation of fitted stock is also provided.

The principal details are:

Wheel arrangement ...	Bo–Bo
Maximum speed	60 mph
Maximum tractive effort	42,000 lb
Continuous rating tractive effort	20,000 lb
Weight in working order	68 tons
Length over buffers ...	42 ft 6 in.
Overall width	8 ft 8½ in.
Overall height ...	...12 ft 6 in.
Bogie Wheelbase	8 ft 6 in.
Bogie pivot centres ...	20 ft
Wheel diameter	3 ft 7 in.

Automatized Brickworks

A rebuilt fully automatized brickworks, entirely planned and constructed in Sweden, has just started

functioning at Iläda, near Stockholm. The number of employees has been halved, although the annual capacity has been increased by one-half; drying requires 48 hours instead of ten times that period previously, and firing takes place in 37 hours instead of 16 days.

Not a single brick is touched by human hands, and even the drying laths are laid automatically and removed automatically before the brick load passes into the firing kiln. An oil-fired tunnel kiln with automatic temperature control gives the bricks a uniform quality. A prerequisite for the fully mechanized replacement of the bricks is the new transfer machine, which stacks the dried raw-bricks emerging from the drying furnace on the tunnel-kiln trolleys in piles. It has been constructed by the Swedish engineer Erik Drakenberg working for AB Mälardalens Tegelbruk.

Welded Chemical Pipework

At the new factory which Chemstrand Limited are building at Coleraine, Northern Ireland, for the manufacture of Acrilan fibre, a considerable footage of piping will be needed to carry various chemical solutions. One of the main requirements is that all pipework should achieve absolute cleanliness so that it can resist corrosion and also to ensure that all solutions passing through it remain constant in colour, so all pipes are being fabricated from 18/8 stainless steel, the majority of which is molybdenum bearing steel. Diameters range from ½ in. nominal bore up to 18 in.

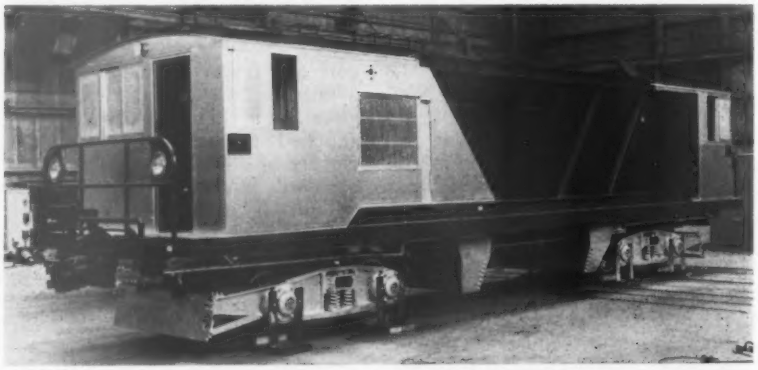
A new welding shop was erected on the factory site at the end of last year, so that all pipes could be fabricated under actual site conditions. Local labour has been specially trained to carry out the work and since November 1957, a total of 19 men have become qualified welders. All welds receive an independent examination on site. This work is being carried out by Welding Supervision Limited. Pipework is hydraulically tested to 250 psi for the working pressure of 25 psi to 100 psi. In the work undertaken to date no leakages have been detected and only 4% of all welds have required repair. The majority of these required only local repair.

Equipment supplied to the welding shop by British Oxygen Gases Limited includes nine sets of Argonarc equipment, comprising ACR 150 rectifier units and 300 amp d.c. generators coupled with variable resistors and H.F. units, together with Mark IIA torches and swivel head pencil torches. Also being used are 42 sets of Saffire oxy-acetylene equipment comprising 36 combined outfits and six hand cutters which are being used for general steel fabrication. A number of Argonarc torches are also being used on site by John Booth & Co. Limited, who are undertaking the welding of stainless steel clad tanks.

All pipes are purged internally with argon gas to prevent oxidization, and prior to use, they will be washed with acid solution and also degreased. Argon consumption to date is approximately 100,000 cu ft.

Conveying Graphite Pneumatically

At the works of The Morgan Crucible Company Limited at Battersea, the movement of graphite has been transformed from a laborious, dirty and slow job with wheelbarrows to a clean and automatic process.



TRANSFER CAR.—The first of an order for two diesel electric transfer cars manufactured in the South Works of Ashmore, Benson, Pease & Company, Stockton-on-Tees. It has been despatched to South Africa after successful trials on a track specially laid to the 3 ft 6 in. South African rail gauge. The diesels were supplied by Rolls Royce. Power was chosen to be generated in this way to eliminate electric 'hot' rails from the highline serving the storage bins of a blast furnace installation in South Africa thus making this area safer for plant operators

The graphite, completely enclosed in its conveying lines, travels in an air stream direct from bulk storage to the required outlets. The material rises some 75 ft to the roof-top plant, from where it is delivered ready for use in the bunkers below. The system, designed and installed by the British Vacuum Cleaner and Engineering Company Limited has a number of notable features. These include level controllers, operating in conjunction with an automatic warning light system to guard against any possibility of over-filling. There is also a spill-out control which shuts off and opens rotary valves to give an automatic regulation of flow of the material in its air stream. The conveying system is complete in itself and designed to handle specific requirements. Its design, however, visualizes the possibility of extensions and provision has been made for the addition of a second exhauster which would offer complete inter-changeability of units on any of three separate conveying lines. The possibility of a more complete pneumatic transit right up to the production points is thus within the capacity of the system as visualized in the present plan. The vacuumation plant used comprises a motor driven turbo-type air exhauster, working in conjunction with a separator unit, extensive fixed pipework and flexible hose lines with aerated loading nozzles.

The system of operation is that the material is loaded into the aerated nozzle through a specially designed feed on the existing hoppers. A controlled air bleed on the loading nozzle entrains the graphite which is then pneumatically conveyed through the hoses and piping to the separator unit mounted on the roof above the produce bunkers. In the separator, the material is extracted from the conveying air by velocity drop, the finer particles being separated through the secondary medium by cyclonic action. By this method the resultant fines are carried through the pipes and finally extracted from the air by a fabric filter fitted in the exhauster unit. The cleansed air is then drawn through the fabric filter sleeves and discharged to the atmosphere through the exhauster outlet.

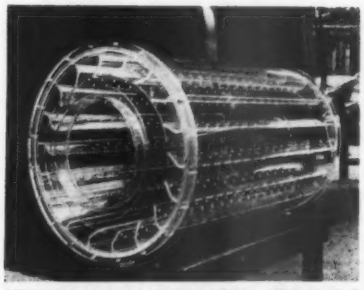
Nuclear Marine Propulsion

The British Nuclear Energy Conference—set up in 1955—has increased its membership to nine constituent bodies by the addition of The Joint Panel on Nuclear Marine Propulsion.

Large tankers and submarines are two types of ships on which nuclear reactors are considered to be economic power units. The Joint Nuclear Marine Propulsion Panel itself consists of four bodies—The Institute of Marine Engineers, The Institution of Naval Architects, The Institution of Engineers and Shipbuilders in Scotland and The North East Coast Institution of Engineers and Shipbuilders.

The B.N.E.C. forms a common forum for engineers and scientists engaged in the application and uses of nuclear energy. Regular meetings are held at which all aspects of their problems are discussed. Proceedings of these meetings are published in the Journal of the B.N.E.C.

The present chairman is Sir Josiah Eccles; previous chairmen were Sir Christopher Hinton (1955–56) and Sir John Cockcroft (1956–58).



PERSPEX MODEL SEPARATOR.—This drum is part of a quarter-scale model used by West's (Manchester) Ltd. to demonstrate the principle of mineral separation by gravity in the Wemco drum separator. The raw feed is separated into light and heavy material, e.g. coal and stone, by the use of a dense medium, the heavy material being lifted into canted vanes and flushed out through a launder, while the light material overflows at the discharge end. The model was made by the Plastics Division of the Triplex Safety Glass Company Limited and affords an example of how accurately Perspex can be shaped, welded and machined

"Fossetts"— A Bicentenary

The Merseyside engineering concern of Fawcett Preston & Company was founded two hundred years ago in the time of the engineering pioneers. It has been in business continuously during these past two centuries making engines for ships, machinery for the sugar and cotton industries, and indeed a host of other things as might be expected of virile and enterprising engineers. To mark the occasion the company has published a very handsome historical volume. Fortunately a good many of the company's records have been preserved and the book contains some interesting facsimiles and a list of some of the 400 ships engined by Fawcetts. It is profusely illustrated, mostly by old prints, and some of them in colour.

Entitled "Fossets," the name by which the company is affectionately known in its neighbourhood, the book is very much in the forefront of the industrial histories which have come our way.

Since 1948 the company has been a member of the Metal Industries Group. Sir Charles Westlake is chairman of both.

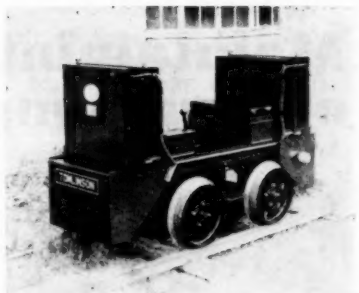
Hydro-electric Scheme Additions

Additions to existing hydro-electric schemes at Storr Lochs in Skye and on the River Moriston in Inverness-shire, will cost £740,000, of which £690,000 will be in respect of the Moriston project. At Storr Lochs the head waters of the River Chracaig will be diverted into Loch Fada to allow of an increase in the output of electricity of some 1·3 million units annually. In Glen Moriston the works proposed will extend the catchment area regulated by Loch Cluanie, the main reservoir of the Moriston scheme, and will increase the output of the two upper generating stations by some 12·2 million units annually.

Vickers's 50 Years in the Air

In July this year Vickers Limited completed fifty years in the aviation business, a period which covers practically the whole of the active development of the industry. It was in 1908 that Vickers were asked to undertake the construction of an airship of the Zepplin type. It was built but was wrecked on emerging from the construction hanger; so the "Mayfly", as it was called, never became airborne.

Successful airships were built later, and then the company took up the manufacture of aeroplanes and seaplanes. It was in a Vickers Vimy that Alcock and Brown made the first direct crossing of the North Atlantic, and another famous machine was the Supermarine which won the Schneider Trophy outright. The notable Vickers machines of the last war were the Spitfire, the



MIDGET LOCO.—This may be the smallest industrial locomotive in the world. It is for use in confined spaces in the Rock of Gibraltar, and for safety and silence is electrically driven. It is 28 in. wide, 66 in. long and will pull a load of 2 tons on 24 in. gauge lines. It was made by Tomlinsons (Electric Vehicles) Limited, of Minster Lovell, Oxford, and uses batteries made by Chloride Batteries Limited, Clifton Junction, Manchester. Internal expanding brakes are fitted to all wheels and the driving wheels are coupled to the motor by differential and worm gear

Welesley and the Wellington. Since the war the company's great commercial success has been the Vickers Viscount which is now being produced continuously at the rate of one every three days.

Half-inch: New Style

A convincing demonstration of the strength of a standard Nettlefolds-Parker-Kalon socket head gap screw was made at the Heath Street, Birmingham, works of Guest Keen & Nettlefolds (Midlands) Limited, when the 9-ton dead weight of one of G.K.N.'s eight-wheeler lorries was lifted by a single ½-in. UNF Nettlefolds-Parker-Kalon socket head cap screw, 5¼ in. long, which had been taken at random from their stock of this product. Securely hoisted, the lorry was safely lowered again and the screw examined and found to be in good, sound condition.

Use of a special high-grade alloy steel, processed to new standards through exacting laboratory torque and tensions testing, now gives strengths which have been stepped up to new high figures.

Welding Largest Dock Gate

The dock gate in the recently-opened Queen Elizabeth Dock, Falmouth, is the largest in the world. It weighs 500 tons and was designed and manufactured by Sir Wm. Arrol & Co. Limited for the Falmouth Docks & Engineering Company. A great deal of welding went into the fabrication of this gate. Site welding was carried out by the Lanarkshire Welding Company Limited using to a large extent, the Flexend and Vertend electrodes of Rockweld Limited.

Maintaining the Efficiency of Wrapping Machines

Principles and procedure for organized maintenance

By J. A. CUCKSON

THE more automatic a production line the greater becomes the cost of breakdown and the time required for re-adjustments. In addition the personnel operating the machinery demand a high efficiency to enable them to earn maximum bonus payment.

Men fully conversant with the construction and working of wrapping machinery are not readily persuaded to leave the employ of the machine maker, so most factory staff have a few days' tuition from the installation man and thereafter are left to their own devices. The usual instruction takes the form of running adjustments and what parts to change if there are different sizes of packages to be worked. Eventually the installation is completed and the various little troubles arise. These are further aggravated if there is shift working, for each fitter quickly develops his own favourite method of how the machine should be functioning and eventually the equipment will produce its work only under difficulty. Very seldom does anyone try to find out what it is that has altered since the machine passed its acceptance tests.

A good machine performance is also a good morale builder to the operating team, but in addition the equipment then gives the lowest possible labour cost for each unit with the minimum of capital expenditure and waste.

To achieve these advantages the machines should be attended by fully competent maintenance fitters who are not only skilled in the art but have the ability to provide quick makeshift yet positive devices to enable the quality of work to be maintained until the job can be corrected with greater finality. A wrapping machine being at the end of the production line is always expected to "wrap up" the failings of other departments. The makeshift items are based on experience, for other than handling the mechanical part of the programme, the fitter is expected to know the answers if such things as paper, foil, cellulose films,

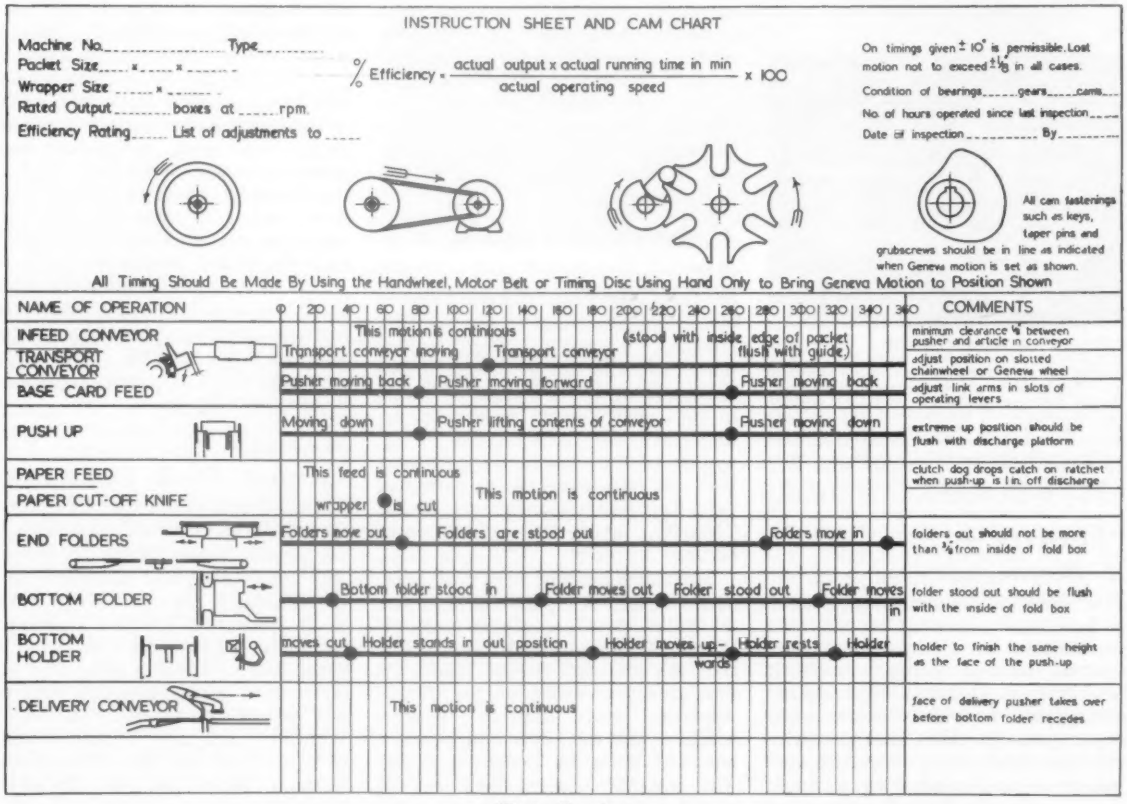


Fig. 1.—Cam chart

solvents, glues, sticky and inconsistent workpieces do not come up to specification.

On matters which are more of a mechanical nature it is astounding how often one sees a fitter changing the timing of a machine when an alteration to the stroke is called for. In a very short time the machine is hopelessly out of phase and the road back can be very tedious if more than one fitter has serviced the same batch of machines.

Wrapping machines are alive with movements. Parts move in all directions and they all have to be synchronized if each part is to perform its own function correctly in its allotted time.

The designer of the machine has had to determine the time that can be allocated to each movement but unfortunately the purchaser of the machine is never furnished with this data. The best procedure is to make one's own cam timing chart of the machine immediately the installation has been completed and accepted. The information one seeks is where the various folders, wrappers or

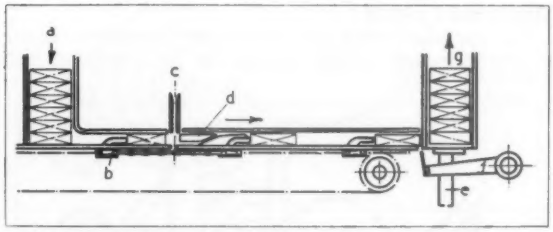


Fig. 2a.—Straight line type of wrapping machine. a, article hopper; b, pusher; c, wrapper feed; d, folding device; e, ejector; f, folder; g, discharge channel

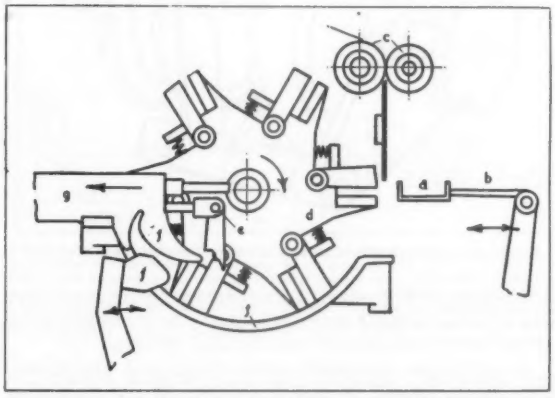


Fig. 2b.—Rotary head of mould wheel type of machine; rest periods are controlled by Geneva wheel, index cam, etc. a, feed belt; b, pusher; c, wrapper feed; d, article holder; e, ejector; f, folder; g, discharge channel

articles to be wrapped should be at a particular time and how much distance they should have travelled.

Purpose of a timing chart

By making the time chart one has:

(a) A pointer to possible causes of faulty machine operation.

(b) A means of insisting that all adjustments are made in a like manner and in correct relationship to timing and stroke.

(c) A check of worn links, pivots, cams, etc.

The timing disc

Before the timing chart can be laid out it is essential that a graduated disc or hand-wheel be available which, for preference, should be divided into 360 divisions representing the degrees of the circle, and numbered off to read in both directions. It may be better if the bore has loose bushes so that the wheel can be affixed at the end of any shaft on the machine.

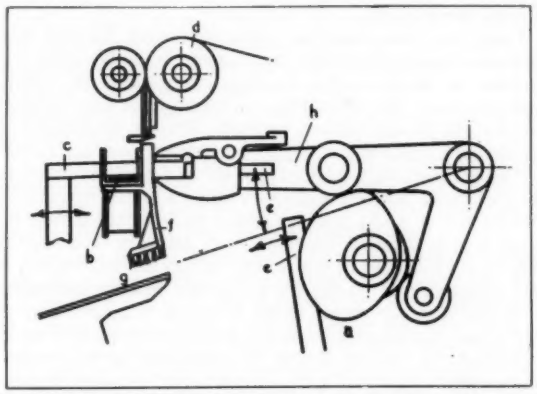


Fig. 2c.—Oscillating holder type of machine which utilizes positive cam drive for the stationary positions. a, driving cam; b, feed belt; c, pusher; d, wrapper feed; e, ejector; f, folder; g, discharge channel; h, article holder

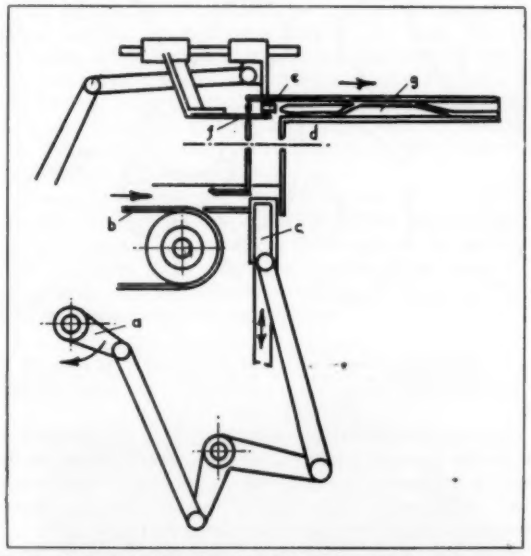


Fig. 2d.—Single station type of machine which is generally driven by means of a crank. a, driving crank; b, feed belt; c, elevator; d, wrapper; e, ejector; f, folder; g, discharge channel

Making the timing chart

A cam chart as depicted in Fig. 1 must be drawn. The names of the movements are indicated as well as the stroke distances with their timings. When this is ready and the timing disc has been screwed on its shaft, the compiling of the chart can proceed.

Starting or setting line

Basically, wrapping machines follow four patterns. One is the straight-through type in which the package is pushed or carried in a straight line and passed into contact with the wrapping devices. The second type works

on the rotary principle where the package is generally held at rest for the loading and wrapping actions to take place. A further type employs an oscillating arm into which the article and wrapper are thrust and then moved through a small arc during which time a portion of the wrapping has been performed, and the article is then ejected into a folding device. The final type is the single station machine in which the loading, wrapping and ejection is performed as the article and wrapper are being moved in vertically.

Generally, the machine calls for some lengthy rest periods during which time the machine must be positively locked to prevent the loading or various wrapping operations to be performed, in which case the designer makes use of the geneva motion. This is generally the place from which the whole of the mechanisms are timed.

The geneva throw roller is set so that it is just entering the slot. This can be checked by using a checking plate as shown in Fig. 3. At this position it may be advantageous if the key, grubscrew, taper pin, etc., that are securing the cams are all drilled in line so that when the timing disc is removed one can readily see if one has become displaced.

In the absence of anything as positive as the geneva stop, then one must assume a starting point such as when a plunger or pusher starts the forwards or backwards movement.

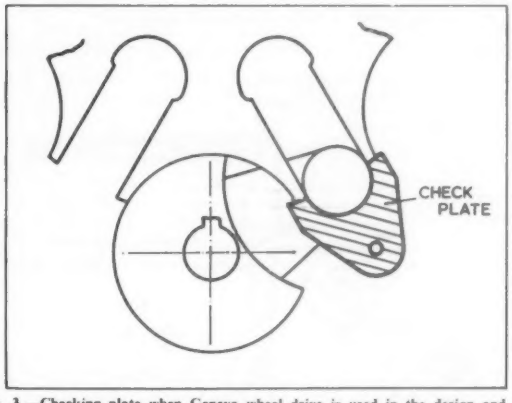


Fig. 3.—Checking plate when Geneva wheel drive is used in the design and for locating the zero position on the cam chart. At this position the keyways, grub screws or taper pins securing the cams should be all in line at some definite orientation

Having determined the starting point, the machine is turned by hand and each start and stop is marked on the chart with special note of critical points. A pointer is fixed to the machine and the graduated disc zero line is brought to register with it as shown in Fig. 4.

After noting each particular movement it is prudent to take the graduated disc to the original setting time to check if any slipping has taken place.

Changing size on the machine

The maintenance staff may be asked to modify the machine to wrap a size of article other than that which the machine was delivered to handle. Usually the majority of the fitters will proceed by re-adjusting bearings and brackets to permit the new work and its wrappers to pass, in which case several new parts will be required with perhaps a large number of cams.

If the matter had been reviewed quietly it would have been seen that only a few sections are worked about the centre line of the machine, while on others one edge of the package will be held up to one face irrespective of the size of the package to be wrapped. There is a limit to the extent of this adjustment but this can be learned from the specification of the machine.

Paper length is achieved by either changing the draw roller diameters and their gearing or by substituting one or more paper feed measuring change gears.

If the number of teeth in the existing gear train is in some relation to the number of millimetres, thirty-seconds, sixteenths or eighths of an inch in the wrapper length, then changing gears only will be necessary.

If the paper length is made by a gripper then there are other points to watch; especially the position of the scissors and the point where the wrapper is placed over the article.

After the change-over has been finalized, records should be made of all the settings, strokes, timings, gear trains, etc., so that they can be repeated after additional size change-overs have been asked for.

By the adoption of this method frequent change-overs can be made with no loss of mechanical efficiency as would be the case if different fitters were left to make their own adaptations.

Maintenance control

The purpose of this article is to try to remove the air of mystery that usually surrounds the adjusting and functioning of high-speed automatic wrapping machinery which in the writer's opinion is due to lack of knowledge of the basic principles of the motions involved.

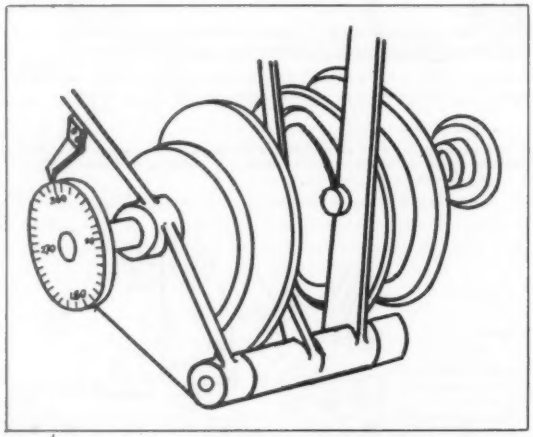


Fig. 4.—Graduated disc placed on camshaft and with pointer fixed to machine

A technician, preferably with design and operational knowledge, should be put in charge. As the packaging equipment becomes more intricate and complex with increased output, those connected with plant upkeep become more and more important. The present tendency of forbidding the operators and personnel on the machines from having access to spanners, screwdrivers, etc., is a step in the right direction providing the maintenance fitter is *au fait* with the machines, for it is not unusual for an operator to have an aptitude for locating operational defects better than some of the fitters.

At the outset the help of the operators must be sought as well as the experience of the various mechanics in keeping the machines functioning, particularly as regards the amount of wear and lost motion that can be permitted before defective packaging is produced. Furnished with the various data to check each machine as to its precise

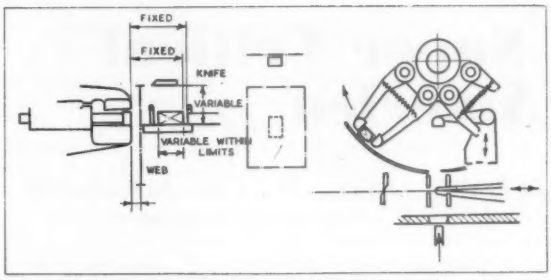


Fig. 5a.—When changing for different sizes some details are worked from fixed faces chiefly for widthwise dimension. The lengthwise dimension is usually central about the centre-line of the machine. For this type of machine the change parts are generally worked centrally in both directions

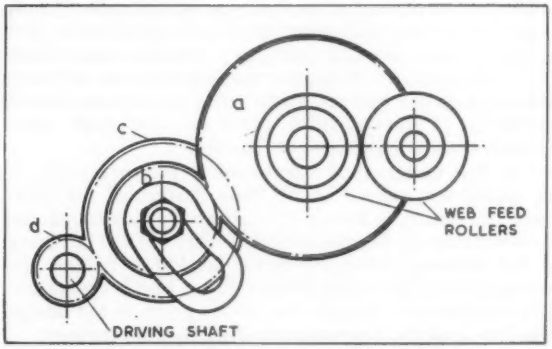


Fig. 5b.—On machines where the wrapper is measured by rollers, check the roller diameters. If circumference is a round figure, either in inches or in millimetres, one can usually assume the change gear pitch circle is the same or some positive multiple of the desired wrapper size. Say web feed rollers are 6 in. circumference, gears a and b are 2:1 and gear c is equal to gear a, and the gear d would have the same number of teeth as there are $\frac{1}{16}$ in. in the length of wrapper

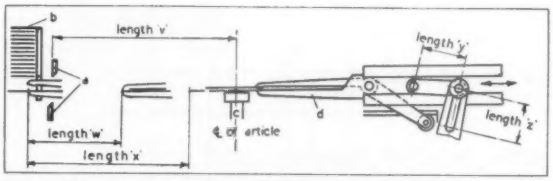


Fig. 5c.—When the wrapper is measured by grippers, five functions are usually to be performed: (i) measure length; (ii) pause to cut wrapper; (iii) position wrapper over article; (iv) move clear; (v) return to original position. Key to diagram: a, scissors; b, label box; c, pusher; d, gripper feed. Length v usually a constant value. If a different length is required, the scissors are adjusted to suit. Length w measured off then pause for cut-off. Length x wrappers positioned over centre of article. Length y variable to compensate for readjustment of scissors. Lenght z variable to give altered length

adjustment and mechanical condition, the whole can then be tied in with planned and scheduled maintenance.

The various checks after tabulation give the following picture:

(a) If the machine has been correctly maintained.
(b) If certain type of faults keep repeating.
(c) If more frequent checks or overhauls are necessary.
(d) If some mechanical part needs modification.
(e) A good indication of parts to keep as stock items and the time intervals for replacement.
(f) What machines or devices are in need of replacement.
(g) When a new machine would be a better proposition because of service and adjustment costs.

It may show that where many packet size and product changes are involved, the providing of complete sub-assemblies of the various devices, located by positive dowels and requiring no further adjustment, may be a better proposition.

There will of course be the usual innumerable minor adjustments before the line is ready for production, but the major change at least is positive.

Good production planning of the various packs can do much to reduce the initial "teething" troubles after each size change. There are times when the day's planned output cannot be met because of some major defect in the equipment. In such cases temporary expedients are necessary and even if the speed of the machines has to be reduced it is better to have produced saleable units at a slightly higher cost than none at all, or to have resorted to hand labour.

Another aspect to maintenance, and one which can be used in conjunction with the timing and checking charts, are sketches used to show the best method of dismantling and re-assembling the various assemblies.

Unless a serious defect has shown itself it can reasonably be assumed that the machine will be kept in production and will only be serviced when it can be spared. However, by conducting these regular checks a body of data is built up which provides a positive basis when a demand has to be made for a machine to be taken out of the line for complete overhaul or repair. The introduction of a planned maintenance scheme is not done without initial cost, but as time goes by maintenance cost is, by its aid, much reduced by reason of the machines being kept in tip-top conditions all the time. The user company could benefit if it sent the maintenance fitter to the works of the machine maker during the time the machine is being erected. If this is not possible then at least the man should have the opportunity of spending the whole of his time with the maker's engineer while installation is going forward.

Successful maintenance lies in providing the staff with specific instructions so that each known trouble that is likely to arise is tackled in the same manner by any fitter, thus ensuring that once the machine has passed its acceptance test the self-same timings, settings and limits will be constantly maintained.

VERNIER DIVIDING TABLE WITH INDEX PLATE.—Model 1730, one of a range of precision dividing tables designed by A. A. Jones & Shipman Limited, Narborough Road South, Leicester which can be used for production and toolroom work. Fast setting is by means of two dividing plates, each having nine rows of holes, giving 20, 32, 38, 39, 44, 46, 49, 52, 56 and 31, 34, 37, 41, 43, 47, 53, 58, 59 divisions, and for more precise work the vernier setting can be used. Model 1730 has a 12 in. dia table, measures 4½ in. high and weighs 140 lb. excluding the carrying cradle. Graduations are to 1° of arc and the table flatness and its plane of rotation are to within 0·0005 in.

Some Comments on Super Critical Pressure Plants in America

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., A.M.I.E.E., Consulting Engineer

THE metallurgical advances of the last decade and experience of the reliability of a very large number of high-pressure plants operating at 2,400 psig since 1940 in America, have encouraged power plant designers there to focus special attention on the planning and construction of a number of novel steam stations operating at super-critical pressures and at higher temperatures. This was undoubtedly a logical step towards ensuring a greater improvement in fuel economy, which has the desired result of reducing the net station heat consumption and increasing the net thermal efficiency per unit sent out.

Although boilers had been seriously conceived and operated at critical pressures, such as the Benson and Loeffler type, about 25 years ago, the turbines were designed for a reduced pressure of 1,900 to 2,400 psig. Such plants were relatively small.

At the critical pressure of 3,206·2 psia the latent heat of water is zero, therefore when water is heated to the critical temperature of 705·4°F. it is converted instantaneously and entirely into steam. The separation of steam from the water occurs in the drum of an ordinary boiler, but in the critical pressure boiler the drum is unnecessary. However, modern tubular boilers produce steam with certainty without drums.

1. Design data of super critical pressure plants in the U.S.A.

The rating, the operating conditions at the boiler and at the turbine, the manufacturer's expected net station heat consumption and the thermal efficiency per unit sent out of America's first six plants, under construction and operating at super-critical pressures and high temperatures are summarized in Table I.

The first commercial super-critical pressure plant in the world was started up at Philo Station of the Ohio Power Company in March 1957. The others are scheduled for operation during the period 1958 to 1960. The rating of the turbines varies from 125 to 450 MW and the boilers from 675,000 to 2,900,000 lb/hr. There is no doubt that considerable thought had to be given to the design problems and the development of these pioneer plants.

Great Britain's planners of more efficient and larger steam stations must not fail to give special attention to this basic information when considering future economic projects. With the anticipated increase in the cost of coal one is compelled to build such super-critical pressure plant without delay.

PRESSURE AT TURBINE STOP VALVE	p.s.i.g.	4500
TEMPERATURE AT TURBINE STOP VALVE	°F	1150
PRESSURE AFTER 1ST REHEATER	p.s.i.g.	1225
TEMPERATURE AFTER 1ST REHEATER	°F	1050
PRESSURE AFTER 2ND REHEATER	p.s.i.g.	185
TEMPERATURE AFTER 2ND REHEATER	°F	1000
VACUUM AT TURBINE EXHAUST (30" Hg. BAR.)	IN. Hg.	28·5
FINAL FEED TEMPERATURE	°F	515

POINT		1	2	3	4	5	6	7
p	p.s.i.g.	0·735*	4500	4500	1225	1225	185	185
t_s or t	°F	91·6	515	1150	736·5	1050	881	1060
T	°F	551·2	974·6	1609·6	1196·1	1509·6	1000·6	1459·6
h_g or H	B.Th.U./LB.	59·6	5060	1505·4	1534·7	1526·8	1290·4	1527·3
ϕ_g or ϕ	B.Th.U./LB./°F	0·1412	0·7071	1·5016	1·5016	1·6445	1·6445	1·8309

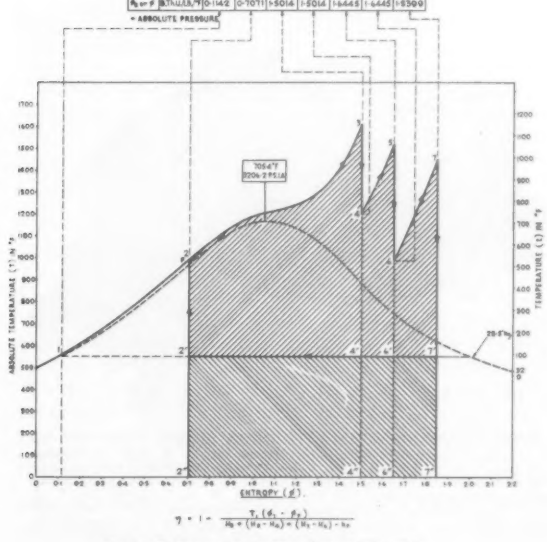


Fig.1.—Regenerative double reheat steam cycle

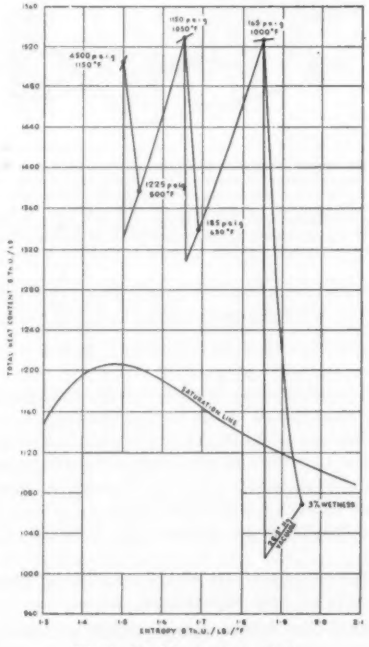


Fig. 2.—Total heat entropy chart

2. The thermal efficiencies of a super-critical pressure regenerative double reheat steam cycle

As Britain's future stations will have to have super-critical pressure plants it is considered desirable to present a detailed analysis of the steam cycle. As an example the Philo conditions have been assumed. With super-critical pressure it is necessary to introduce double reheating in order to get the maximum cycle efficiency.

The steam conditions and the thermodynamic values at the feed heating and reheating points are indicated in Fig. 1, which also shows the cycle in the total temperature-entropy diagram. The condition line is presented in the total heat-entropy chart in Fig. 2. For the regenerative double reheat efficiency no allowance has been made for the pressure drop in the reheats, for it is presented as an ideal efficiency.

For the Philo conditions the cycle efficiencies and their respective ratios are recorded in Table II.

The net station thermal efficiency per unit sent out for Philo, Eddystone No. 1 and No. 2 sets, Avon and Philip Sporn Station are plotted in relation to initial pressure at the turbine stop valve in psig in Fig. 3. The value for Breed Station is the same as Philip Sporn as they are identical plants in every respect.

The diagrammatic arrangements of the feedheating for Philo and Eddystone No. 1 are indicated in Figs. 4 and 5 respectively.

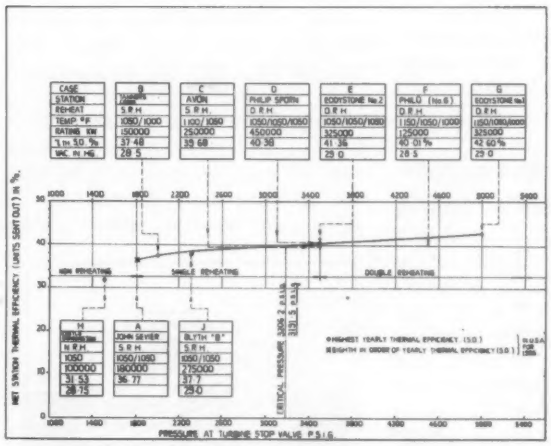


Fig. 3.—Net station thermal efficiency (unit sent out)

3. Comparison of the performance of an up-to-date British station with Philo in America

The most up-to-date station selected for this comparison is Blyth–B which has a 275 MW set operating at 2,300 psig and 1,050°F. at the turbine stop valve with single reheating to 1,050°F. at 567·2 psig, 29-in. Hg vacuum, a final feed temperature of 486°F. and seven-stage feed heating. Except for the vacuum the design conditions apply also to the 550 MW cross compound turbines of Thorpe

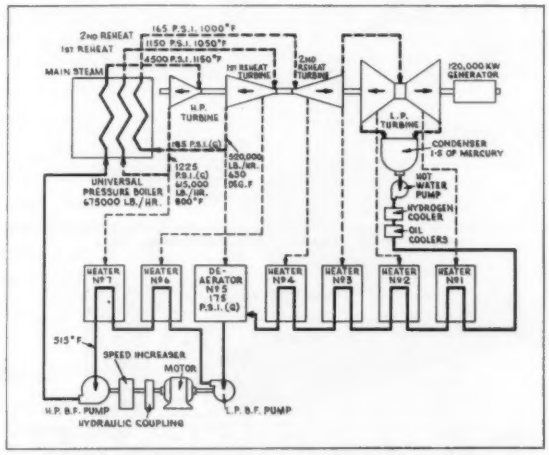


Fig. 4.—Diagrammatic arrangement of feed heating system for the Philo set

Table II.—PHILO CONDITIONS AND CYCLE EFFICIENCIES

(1)	Carnot Efficiency	65·73%
(2)	Regenerative reheating efficiency	56·26%
(3)	The expected station thermal efficiency (unit sent out)	40·00%
(4)	Ratio (2)/(1)	0·8559
(5)	Ratio (3)/(1)	0·6085
(6)	Ratio (3)/(2)	0·7101

Table I.—DESIGN DATA OF SUPER-CRITICAL PRESSURE PLANT IN U.S.A.

1	2	3	4	5	6	7	8	9
	Power Station	Units	Philo	Eddystone No. 1	Eddystone No. 2	Avon	Breed	Philip Sporn
	Power Company		Ohio Power Company	Philadelphia Electric Company		Cleveland Electric Illuminating Company	Indiana and Michigan Electric Company	Ohio Power Company and Appalachian Electric Power Company
1	Scheduled for Operation	—	Dec. 1956	1959	Early 1960	Early 1959	Late 1958	Late 1959
2	Maximum rating of set	MW	125,000	325,000	325,000	250,000[1]	450,000	450,000
3	Pressure at Turbine Stop Valve	psig	4,500	5,000	3,500	3,500	3,500	3,500
4	Temperature at Turbine Stop Valve	°F	1,150	1,150 (initial) 1,200 (ult.)	1,050	1,100	1,050	1,050
5	Temperature after 1st Reheater	°F.	1,050	1,050	1,050	1,050	1,050	1,050
6	Temperature after 2nd Reheater	°F.	1,000	1,050	1,050	—	1,050	1,050
7	Steam Flow through Turbine Stop Valve	lb/hr	675,000	2,000,000	2,178,000	1,715,000	2,900,000	2,900,000
8	Manufacturer of Turbine	—	G.E.	W.E.	G.E.	W.E.	G.E.	G.E.
9	Number of Shafts	—	1	2	2	1	2	2
10	Number of feed heating stages	—	7	9 (parallel)	8 (parallel)	8	9	9
11	Manufacturer of Boiler	—	B. & W.	C.E. Co.	C.E. Co.	C.E. Co.	B. & W.	B. & W.
12	Arrangement of Furnace	—	Single	Twin	Twin	Twin	Single	Single
13	Boiler Feed Pump Drive	—	Motor	Motor and Turbine	Motor and Turbine	Turbine[5]	Turbine[5]	Turbine[5]
14	Arrangement of Feed Pumps and Heating	—	L.P. Pump H.P. Heaters H.P. Pump	L.P. Pump H.P. Heaters I.P. Pump H.P. Pump	L.P. Pump H.P. Heaters I.P. Pump H.P. Pump	L.P. Pump H.P. Pump H.P. Heaters	Pump H.P. Heater	Pump H.P. Heaters
15	Station Heat Consumption (expected)	B.Th.U./kw hr	8,530	8,016[3]	8,250[3]	8,603[4]	8,450[4]	8,450[4]
16	Station Thermal Efficiency (expected)	%	40·01	42·60	41·36	39·68	40·38	40·38

[1] Rating based on gross generation less power or steam equivalent for feed pump drive.
[2] At steam flow indicated.
[3] With one motor-driven B.F. pump and one turbine-driven pump, the heat consumption is 8,360 B.Th.U/kW hr for two turbine-driven pumps.
[4] Based on preliminary design.
[5] Also motor-driven pumps for starting and emergency back-up.

Marsh. The thermodynamic value and the cycle presented in the total temperature-entropy diagram, are shown in Fig. 6. The cycle efficiencies and their corresponding ratios for Blyth–B and Philo are indicated in Table III.

The net station efficiency at Blyth–B has been estimated by the writer as 37·7%. It must be regarded as an optimum value, and is plotted at 2,300 psig in Fig 3.

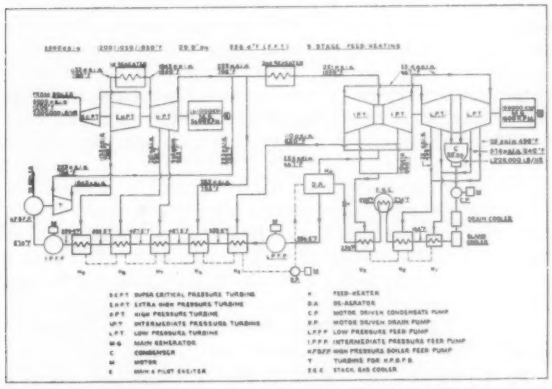


Fig. 5.—Diagrammatic arrangement of feed heating system for the 350,000 kW cross compound double reheat turbine for Eddystone set No. 1

PRESSURE AT TURBINE STOP VALVE.	P.S.I.G.	2300
TEMPERATURE AT TURBINE STOP VALVE.	°F	1050
PRESSURE AFTER REHEATER.	P.S.I.G.	576·2
TEMPERTURE AFTER REHEATER.	°F	1050
VACUUM AT TURBINE EXHAUST 30 Hg.BAR	IN. Hg	29·0
FINAL FEED TEMPERATURE.	°F	486.

POINT	UNIT	1	F	2	3	4	5	6
P	P.S.I.G	29·5" Hg VAC	584·2	2300	2300	2300	641·9	576·2
P	P.S.I.A.	0·490	598·9	2314·7	2314·7	2314·7	656·8	590·9
T_s OR t	°F	78·9	486	656·8	656·8	1050	675	1050
T	°F	538·6	945·7	1116·5	1116·5	1509·7	1134·7	1509·7
hs OR H	BTHU/LB	46·8	471·6	708·1	1109·9	1494·0	1331·1	1542·9
ϕ_s OR ϕ	BTHU/LB	0·0912	0·6720	0·8938	1·2528	1·5606	1·5606	1·7333

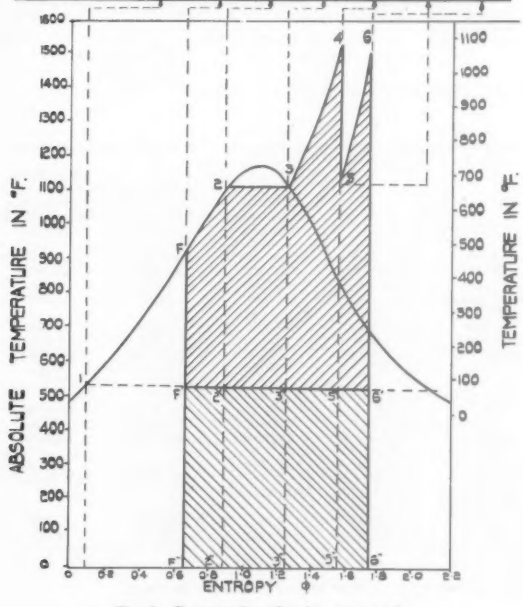


Fig. 6.—Regenerative reheating steam cycle

In comparing the net thermal efficiency per unit sent out for Blyth–B with Philo, one finds that the latter is 6·1% higher.

4. The capitalized value of the improvement in the thermal efficiency

It is instructive to assess the capitalized value of 1% improvement in the thermal efficiency of a 275 MW set at Blyth–B.

Assuming:

(a) a calorific value of coal of 10,000 B.Th.U./lb
(b) a load factor of 80%
(c) an interest rate of 6%
(d) a redemption period of 25 years
(e) a cost of coal of 90 shillings per ton in 1960, when the plant is in commission.

One finds:

(1) the coal consumption per unit sent out	0·9053 lb/kW hr
(2) the fuel cost per unit sent out	0·4364 d/kW hr
(3) units sent out per annum	1,927·2 million kW hr
(4) Cost of fuel per annum	£3,500,125
(5) Saving per annum per 1% improvement in the thermal efficiency	£35,000
(6) Capitalized value of 1% improvement over 25 years at 6%	£447,300

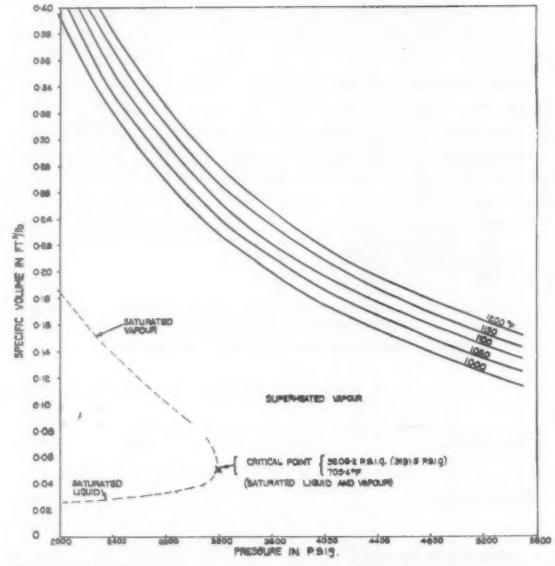


Fig. 7.—Specific volume of saturated and superheated steam for 2000 to 5600 p.s.i.g. Plotted from J. H. Keeman and F. G. Keyes tables (1949)

Table III.—A COMPARISON OF THE STEAM CYCLE THERMAL EFFICIENCIES

	Philo	Blyth B	
1. Maximum continuous rating	125	275	MW
2. Pressure at turbine stop valve	4,500	2,300	psig
3. Temperature at turbine stop valve	1,150	1,050	°F.
4. Pressure after first reheater	1,225	576·2	psig
5. Temperature after first reheater	1,050	1,050	°F.
6. Pressure after second reheater	185	—	psig
7. Temperature after second reheater	1,000	—	°F.
8. Vacuum at turbine exhaust (30 in. Hg bar.)	28·5	29·0	in. Hg.
9. Final feed temperature	515	486	°F.
10. Number of feed heating stages	7	7	—
11. Carnot efficiency	65·73	64·32	%
12. Regenerative reheating efficiency	56·26	53·69	%
13. Expected thermal efficiency (Units S.O.)	40·00	37·70	%
14. Ratio (12)/(11)	0·8559	0·8349	
15. Ratio (13)/(11)	0·6085	0·5861	
16. Ratio (13)/(12)	0·7101	0·7021	

(7) Capitalized value of 1% improvement for 25 years at 6% per kW of maximum continuous rating at 275 MW £1·627

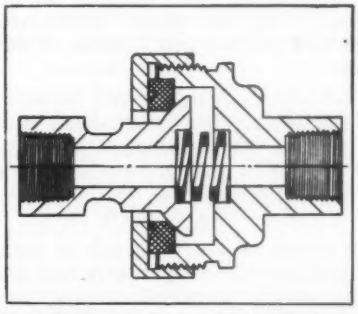
As the Philo plant has a 6·1% higher thermal efficiency than Blyth–B power station, the above analysis reveals that the capitalized value over a period of 25 years at 6% interest is £2,728,530 which represents a saving in fuel cost for each 275 MW set and therefore corresponds to £9·922 per kW of installed maximum continuous rating.

An allowance has also to be made for the extra initial capital cost for such super-critical pressure plants.

It must be appreciated that for the same temperature an increase in the initial pressure from 2,300 to 4,500 psig, the specific volume of steam is reduced to 45%. Consequently the sizes of the pipes, the valves and the steam chests are reduced to about 30%. The specific volume of the water and the saturated and super-heated steam for pressures from 2,000 to 5,600 psig are plotted from J. H. Keenan and F. G. Keyes Tables (1949) in Fig. 7.

Swivel Joint Self-sealing at all Pressures

Introducing flexibility in pipe lines is always a problem when space limitations or existing design features preclude the use of flexible hoses. A simple approach to the problem without resort to costly ball-joint construction has been made by Hilyn Industrial Equipment Limited, Hilyn Works, Brimsdown, Enfield, Middlesex, with the Hilyn swivel joint which permits full rotational movement of 360° and a 10° angular or side movement without flow restrictions. The construction is shown in the diagram—the internal fluid pressure reacting upon the base of the moving part provides the sealing force between mushroom



Sectional view of the Hilyn swivel joint. The tension spring ensures a tight joint at low pressures

section of the end connexion and the P.T.F.E seal. Additional support is provided by a specially tensioned spring which even at very low pressures ensures a completely pressure tight joint. The joint requires little or no manual adjustment. Constant maintenance is no longer necessary with the Hilyn joint thus resulting in a large saving in labour costs.

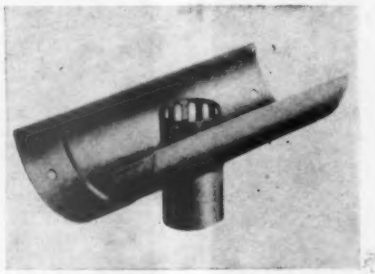
Machined from B.S.U. gunmetal it is suitable for steam, water, air, etc., although the joint can be manufactured in malleable iron, aluminium or stainless steel alloys if desirable. Available in elbow or straight patterns from ¼ in. B.S.P. to 2 in. B.S.P., sizes up to 6 in. B.S.P. can also be supplied to this design. A P.T.F.E. seal is fitted to the standard range of swivel joints.

Subjected to authoritative test pressures exceeding 2,500 psi the joint has remained completely pressure tight although for normal industrial applications it can be used with complete reliability up to 500 psi and temperatures up to 485° F.

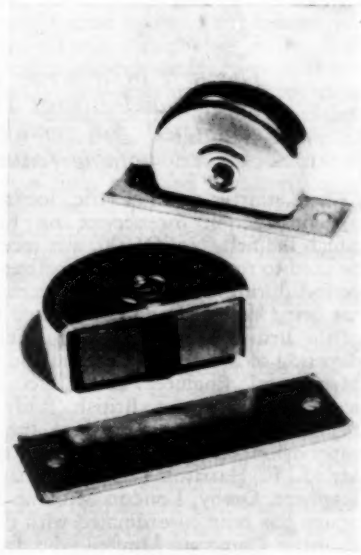
Magnetic Door Catches

The latest Eclipse magnetic device to be offered by James Neill & Company (Sheffield) Limited, Sheffield 11, is a magnetic door catch, available in two sizes, No. 870 for light doors of cabinets, caravan or boat lockers and tool and workshop cupboards, and No. 871 for use on heavier hinged or sliding doors.

The catch comprises a powerful permanent magnet flexibly mounted in a silver anodised aluminium housing, and a drilled, plated striker plate. It is simple to fix, requiring no woodworking alterations; and being self-aligning by means of the floating magnet is highly efficient in action.



Harco half-round gutter outlet



Eclipse magnetic door catch

Preventing Gutter Outlets Choking

A new device which should prevent gutter outlets, down pipes and drains being blocked by leaves and other rubbish, has been developed by G. A. Harvey & Company, Woolwich Road, London SE7, for use in domestic and other buildings.

The device, the Harco gutter outlet leaf guard is extremely simple, consisting merely of an extension of the nozzle up into the trough of the gutter outlet. The extension has a number of apertures in it through which the water flows but leaves or other waste material are prevented from entering the nozzle and down-pipe. If the apertures should become completely blocked, water will flow over and down the outlet, as the top of this outlet is below the level of the rim of the gutter.

This leaf guard is now a standard feature of Harco gutter outlets, in sizes of 4 and 4½ in., half-round and O.G. The gutter outlet for pressed-steel guttering is priced at between 6s. and 7s.

BR Type 2 Diesel-electric Locomotives

Exterior view of first main-line diesel-electric locomotive, No. D.5000, of 1160 hp, erected in B.R. workshops (Derby, 1958)

The first of a series of 1160 hp diesel electric locomotives fitted with Sulzer engines and British Thomson-Houston electrical equipment has recently been completed for service on British Railways. The design has a number of notable features and the equipment is particularly complete

THE thirty diesel-electric locomotives now under construction for service on British Railways, of which the first, No. D5000, was recently completed, will be used to replace steam locomotives and for the interim period during electrification of certain main lines. They are being designed and constructed to the requirements of the British Transport Commission under the general direction of Messrs. R. C. Bond and S. B. Warder (Chief Mechanical Engineer and Chief Electrical Engineer respectively, of the British Railways Central Staff, British Transport Commission), the detailed design and supervision of construction being the responsibility of Mr. J. F. Harrison (Chief Mechanical and Electrical Engineer, Derby, London Midland Region). The whole design has been co-ordinated with the British Thomson-Houston Company Limited who are the main contractors for the power equipment, and with Sulzer Brothers Limited the diesel engine manufacturers.

The locomotives are built to a 12 ft 8 in. high loading gauge and are equipped to work in multiple with others of the same design and with all B.R. locomotives with BTH, Crompton-Parkinson or English Electric equipment. Fifteen of them will go into service on the Southern Region, five on the London Midland Region, and ten on the Eastern Region.

Frame and structure

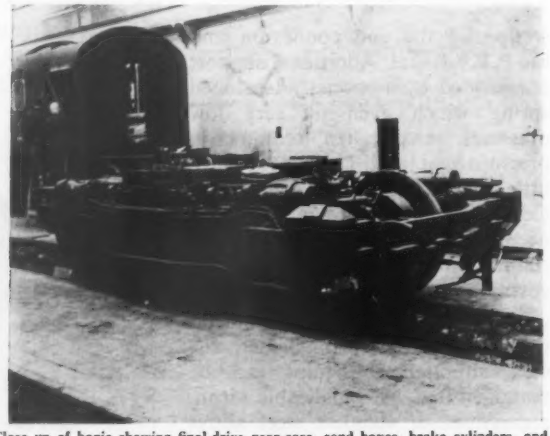
A light construction has been obtained by using aluminium alloy for the drivers cabs (including floor and floor supports), roof hatches, radiator fan housing, radiator ducting, cab and gangway doors, air louvres in housing sides, main floor plates and various cover and filling in plates, control cubicle and toolboxes. In addition the roof of each cab is moulded in fibreglass reinforced polyester resin.

The underframe consists of two longitudinals, each comprising two standard channel sections placed back to back, the intervening space being enclosed top and bottom to form air ducts for ventilation and traction motor cooling. The longitudinals form the foundation for the four point mounting of the engine generator set, and are tied together by two main transomes carrying the bogie centre pivots and by other members all of double channel section. The side girder frames are welded to these transomes and are tied together at the top by the roof frames.

A cable duct with oil- and water-tight covers has been provided along one side of the main longitudinals and on the other side pipe lines run underneath the floor. The locomotives are fitted with oleo pneumatic buffers and centre draw hook, but provision has been made for the later addition of automatic central couplers.

The superstructure embraces a driving cab at each end, the power unit and controls compartment and the carriage warming boiler compartment with communicating doors between each. Side access covers and roof

Locomotive D.5000 with fibre-glass roof removed showing diesel engine, cooling system and fan



Close up of bogie showing final-drive gear-case, sand boxes, brake cylinders, and bogie bolster

hatches are provided to facilitate installation and removal of major units, and also maintenance work. Air filters are fitted in the body side panels to ensure clean air in the engine generator compartment, and special care has been taken in sealing all possible sources of leakage of unfiltered air into the engine compartment.

The complete locomotive is lined, including the cabs, with Fibreglass Navy Board, thicknesses varying from ¾ in. to 2 in. thick on either side of the cab bulkheads.

The silencer is of large volume and comprises separate expansion and resonator chambers lagged to prevent heat radiation.

A self-draining sealing plate is provided under the floor for the full length of the locomotive between cab bulkheads to prevent leakage oil and water getting on to the bogies and battery equipment. Clean fuel spillage is collected separately and ducted back to the main fuel tank.

The driving cabs are spacious with the two side doors placed behind the driver's and assistant's seats. Cab heating and ventilation combined with a screen demister is fitted, fresh air being blown by an electrically-driven blower through heating elements fed from the engine cooling system and under the control of the driver. The unit can be used for blowing cool air in exceptionally hot weather. Screen wipers are provided, and also a two-tone warning device. There is an electric cooker in each cab.

The seats are comfortable and adjustable, and the various controls and indicators are conveniently and neatly arranged. A minimum of instruments confronts the driver. There is a wheel slip light and "engine stopped" light together with boiler and power equipment fault lights. These indicator lights glow dimly under normal conditions, but come up brightly when a fault occurs. A detailed indicator in the engine compartment shows which actual part of apparatus is giving trouble.

The bogies are of welded and riveted construction with box frames, and are of the spring bolster type. Primary suspension consists of two sets of coil springs arranged on each equalising beam damped by hydraulic shock absorbers. The bolster rests on the spring plank through two nests of coil springs, the motion of which is also damped by shock absorbers. The spring plank is suspended by four swing links pin-jointed with hardened steel bushes at the top and knife edged at the bottom connexion to the spring plank. Bogies of the first ten locomotives are to be fitted with Skefko axleboxes, those on the second series of ten will have Isothermos axleboxes.

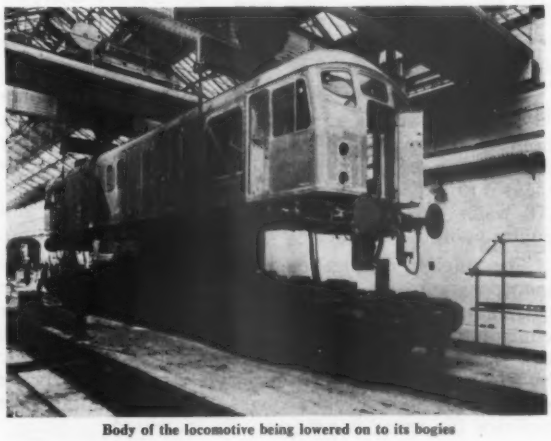
Brakes

The brake equipment is of the Oerlikon type made by Davies & Metcalfe with Westinghouse brake cylinders. A straight air brake is provided for the locomotive operated through the driver's straight air brake valve in the cabs.

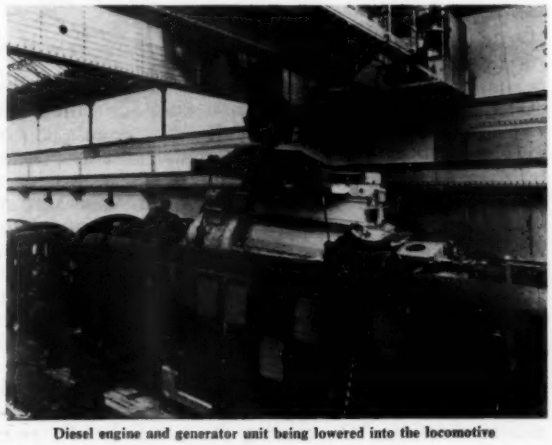
An automatic vacuum brake is provided for the operation of the brake on the train, this being controlled by a driver's vacuum brake valve in each cab. The operation of this valve also controls, through a vacuum/air proportioning valve, the air brake on the locomotive independently of the driver's straight air valve. The vacuum/air proportioning valve is designed so that the air brake on the locomotive is automatically applied in proportion to and in synchronism with the application of the vacuum brake on the train. It also releases the air brake on the locomotive in proportion to the increase in vacuum in the vacuum train pipe and is, therefore, in synchronism with the release of the vacuum brake on the train. A brake cubicle is provided in which the majority of the brake valves are contained, to facilitate maintenance and ensure cleanliness.

Each bogie carries four 8-in. Westinghouse horizontal brake cylinders, each incorporating a slack adjuster. Air for the locomotive brakes and for the air-operated control equipment is provided by a Westinghouse DVC.2 compressor with a capacity of 39·5 cfm against a pressure of 100 psi in the main reservoir. Vacuum for the train is provided by two Westinghouse 4V. 110-G exhausters with a combined capacity of 220 cu ft min at 1,000 rpm.

In addition to conventional sanding, the anti-slip brake, already well established on the Continent, makes its first appearance in this country. The anti-slip device consists of two relays fitted singly between the two motors of each bogie and any variation in speed of the motors creates a voltage differential which causes the indicator light in the cab to glow brightly. When this occurs, the driver eases off the power control lever and presses the anti-slip button which gives a slight brake application through the medium of an electrical impulse to the diaphragm of the air brake valve. Dimming of the indicator light occurs when the slip has been controlled and the power lever may then be opened up. Separate operating switches are provided for the anti-slip brake and for sanding.



Body of the locomotive being lowered on to its bogies



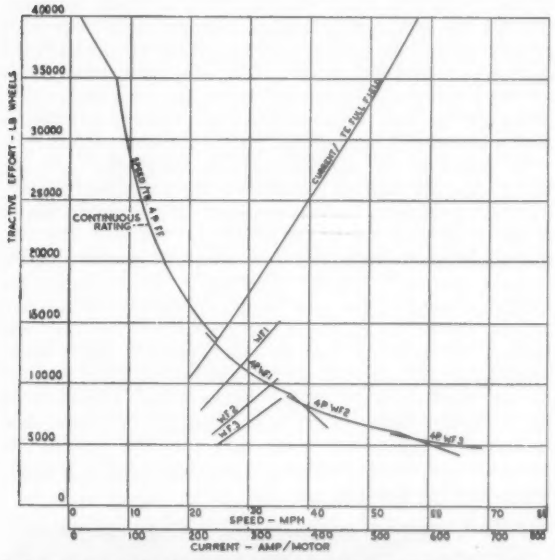
Diesel engine and generator unit being lowered into the locomotive

Power unit

The engine is a Sulzer 6LDA.28, pressure charged six cylinder four stroke in line engine rated at 1,160 hp at 750 rpm. Five of the engines are being supplied from Sulzer Brothers' Works in Switzerland and the remaining twenty-five to Sulzer orders at Messrs. Vickers-Armstrongs Works at Barrow.

The generator unit comprises three machines; a main generator, an auxiliary generator and a differential exciter. The main generator is a single bearing, 12 pole, separately excited and self-ventilated machine. It is a 735 kW machine rated at 750/525 volts, 980/1,400 amps, 750 rpm. The auxiliary generator is an eight pole, separately excited, constant voltage machine of 32/50 kW, 110 volts, 325/750 rpm, the armature being mounted on an extension of the shaft of the main generator. The exciter is a four pole machine with separate, self and differential series excitation windings and is mounted on an adjustable platform on top of the auxiliary generator frame. It is belt driven from the main generator shaft extension.

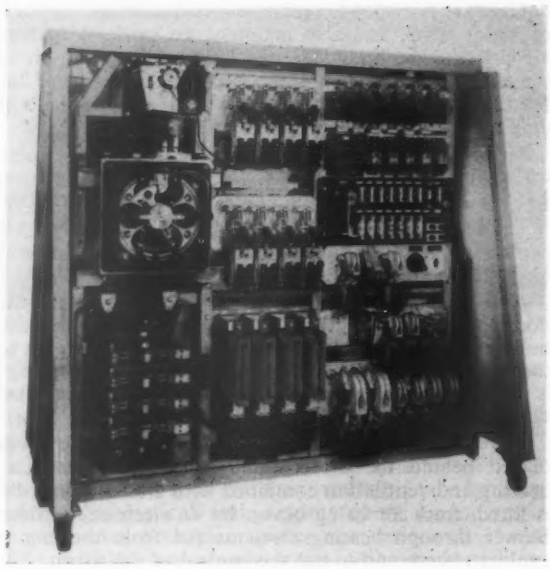
The four traction motors are BTH type 137, BY, 4 pole, continuous rating of 213 hp, 525 volts, 350 amps, 1 hr rating of 209 hp, 490 volts, 375 amps. There are two on each bogie, driving through single reduction



Performance curves of the locomotive, based on 1085 hp input to generator at 750 rpm

gearing. The motors are force ventilated by two blowers driven by one 12·2 hp motor, continuous rating 110 volts, 103 amps, 2,600 rpm, each blower serves a pair of motors. The motors are axle hung and nose suspended by Metalastik chevron rubber units, which provide a soft vertical suspension and effect a large measure of lateral control of the motor irrespective of side movement of the axle, thus reducing tyre flange wear and improving the riding of the locomotive. The gearwheels are of resilient construction and consist of a hob and toothed rim connected through rubber bushes which cushion mechanical shocks due to accelerating forces and track irregularities.

Complete control of the main traction equipment is obtained by a self-lapping air valve operated from the master controller. On moving the power handle away



The control gear

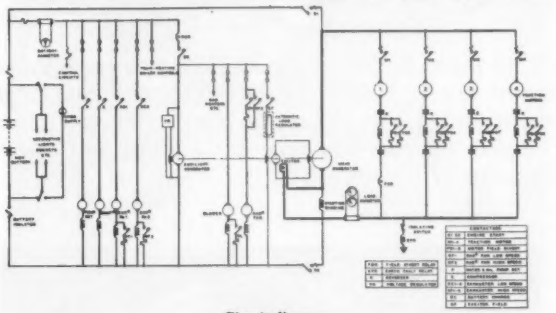
from the "O" position, the load regulator first runs up, increasing the excitation and therefore tractive effort. At a certain point, the main engine characteristic is reached and thereafter engine speed and power rise together, until full rated horsepower is reached. This control is achieved without the use of "notching" contactors. Maximum tractive effort is reached at a very low engine speed so that racing the engine to start the train is completely unnecessary. Field weakening is introduced in stages initiated by the generator load regulator. The traction motors are arranged in permanent parallel across the main generator and there are two stages of field weakening.

The control gear is mounted in a cubicle near the main generator and includes pneumatic contactors for the four traction motors and electromagnetic contactors for engine starting and motor field weakening. The battery is contained in four pull-out boxes suspended from the underframe. Of the first twenty locomotives, ten will have lead acid DP type RK.144 batteries of 48 cells capacity 144 amp/hr 5-hr rate, and the remaining ten will have alkaline NIFE type DL.15 batteries of 72 cells capacity, 155 amp/hr, 2-hr rate. Battery charging sockets, external lighting connections, hand inspection lamp sockets, are provided on each side of the locomotive at solebar level.

Steam for carriage warming is provided by a Stone-Vapor boiler having a capacity of 1,500 lb of steam per hour at 60 psi. The apparatus is automatic and fully protected. The T.I.A. system of boiler feed water treatment is provided incorporating a hydrostatic doser tank. All water tanks and circuit pipes for boiler feed and engine cooling water are galvanised to prevent corrosion.

The engine cooling is a complete by-pass system incorporating self-draining radiators and serves the double purpose of giving full automatic temperature control together with complete frost protection at all times. It incorporates a servo-operated thermoststic by-pass together with four-position control whereby the radiator is progressively brought into operation and the radiator fan speed is progressively increased.

Filling and draining points are provided on each side of the locomotive in order to facilitate servicing. In addition a compressed air connection (10 psi) is provided



Circuit diagram

at each side of the locomotive to facilitate fuelling from a tanker wagon, if necessary.

A fixed CO_2 installation is provided consisting of three 50 lb CO_2 cylinders which are manually operated from the driving cabs and from external positions and accessible from ground level, also two 2½ lb (squeeze grip) CO_2 gas extinguishers and one quart C.T.C. extinguisher are provided in each cab. Fire detectors are also provided and these operate an alarm bell in each driving cab. There is no automatic release of foam, this being under the control of the locomotive crew.

Lifting and jacking points, including towing eyes, etc., are provided at suitable locations on the locomotive. These facilities have been designed not only for main workshop requirements but also to facilitate re-railing of the locomotive in case of accident.

Leading particulars

Wheel arrangement	BB
Max. weight in working order	75 tons
Max. axle load in working order	18¾ tons
Diesel engine hp at continuous rating	1,160 at 750 rpm
Max. tractive effort	40,000 lb
Continuous tractive effort	21,300 lb at 15 mph
Max. speed permitted	75 mph
Min. curve	4½ chains without gauge widening
Wheel diameter	3 ft 9 in.
Length over buffers	50 ft 6 in.
Distance between bogie centres	28 ft
Bogie wheel base	8 ft 6 in
Fuel capacity (engine and boiler)	630 gall
Water capacity, boiler feed tanks	600 gall

Fuel Oil Additive Prevents Sludge

Formation of harmful residues in fuel oil storage tanks is being prevented or reduced to harmless levels through addition of small amounts of a chemical developed by scientists of the Du Pont Company and already in wide use in the United States. In addition, the new product, called Du Pont Fuel Oil Additive No. 2, has been used at higher than normal concentrations to remove accumulated deposits without interfering with normal operations.

The residues are insoluble resins and sludge which form during storage through the reaction of unstable components with each other and with oxygen. These reaction products may be soluble in the fuel in which they are formed, but insoluble in fuel oil of a different type. Therefore, whenever distillates and catalytically cracked components, for example, are mixed and stored for appreciable periods, precipitation of sludge may occur.

Typical installations where mixing of fuel oil may create this problem are refuelling tanks for diesel locomotives, fuel tanks on ships and storage tanks at distribution centres.

An example of savings through use of the new additive is provided by the experience of the Du Pont Company itself. A six-inch deposit of sludge was found to have accumulated in a 50,000 gal tank for residual fuel oil. In one week, through the action of the additive the deposit was eliminated, with no interference with operations.

The Du Pont additive is claimed to overcome fuel instability in three ways, it prevents interaction of non-hydrocarbon constituents which form residue, helps to dissolve residues already formed, and suspends insoluble particles harmlessly in the fuel oil.

Tube Seam Grooving Machine

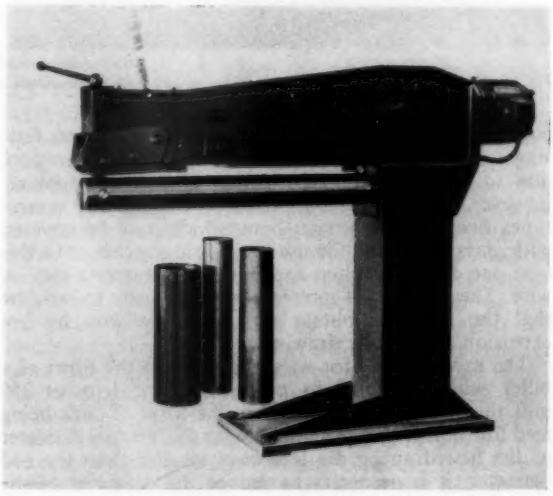
This Besco Model G grooving machine is designed for closing the previously hooked edges of the side seam on air ducting, stove piping, drums, etc. Tubes and rectangular or square trunk sections or even plain sheets up to a total length of 72 in. × 16 swg mild steel, can be handled in two operations.

The machine, built by F. J. Edwards Limited, 359-361 Euston Road, London NW1, is column mounted for floor location and the grooving head is stationary. The rigid location of the machine and positive and steady grooving action is claimed to produce a more even and closer seam than that obtained with the old type of travelling grooving carriage.

Operation of the machine is simplicity itself; the material is placed over the 4¼ in. dia mandrel at the front, the pressure adjusted by means of the hand lever on top of the seaming head, and the one hp motor started. The work is fed through the seaming or grooving head, and on contacting the micro-limit switch at the other end of the mandrel, the power is automatically switched off. By pressing the "reverse" push-button the work is returned through the grooving head. Three top rollers for outside seams to suit 20, 18 and 16 swg and a plain bottom roll are supplied with each machine. Rollers for inside seams are available, if required.

When working on maximum capacity and depending on the nature and thickness of the material being used, a more satisfactory result is obtained if the work is passed through the grooving head a number of times.

The net weight of the machine is 1,218 lb; the working height of mandrel is 35¾ in. and effective length 26 in.

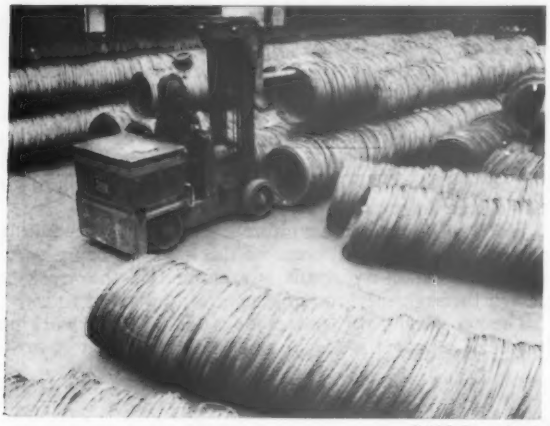


Besco Model G tube seam grooving machine

Progress in Wire Drawing

Each successive year sees an increase in the production of wire, needed for such diverse purposes as ropes, reinforced concrete, the electrical industries, etc. Recent improvements in the technique of wire drawing, apart from those made in drawing machines, centre around dies, their lubrication, and heat-treatment of the wire

AS one watches wire being drawn through a series of dies, the first impression is that it is a process of stretching. Actually, however, it is one of plastic flow, and the resistance which the hard wall of the die offers to the softer metal contacting it causes the latter to flow. In many cases it is an extreme example of cold working, but not in all instances, for some wire—tungsten is one—is heated before drawing. This process of plastic flow can be carried on until the wire is reduced to a diameter of only a few mils, providing that the flow is carried out in easy stages by the use of a number of dies, and provided the metal is maintained in a condition for flowing through suitable heat-treatment. An example of the extraordinary limits to which the drawing process may be carried is the production of 16 miles of 2-mil

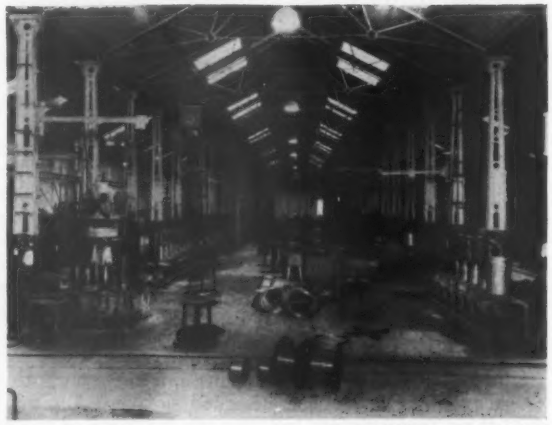


British Ropes Limited

Fig. 1.—Steel rods prior to drawing; horizontal bar on fork truck accommodates a number of coils

copper wire from 6 ft of ¼-in. copper rod. The final stages of drawing such fine wire is a delicate operation, due to the low strength of the wire. The Russians, however, claim(1) to have produced copper wire several times finer than a human hair, which may be covered with glass insulation for use in electric watches. In this case one drop of molten copper produces over a mile of wire. The mention of molten copper appears to indicate that the Russians obtain this very fine wire by hot extrusion and not by drawing.

The raw material for wire is usually in the form of a billet, which is rolled to produce rod of ¼-in. or 250 mils thickness; lengths of rod in the form of coils being feed for the drawing machines. Since the internal diameter of the first drawing die is always smaller than the rod diameter, it is necessary to reduce the diameter of the end of the rod before it can enter the first die. This is



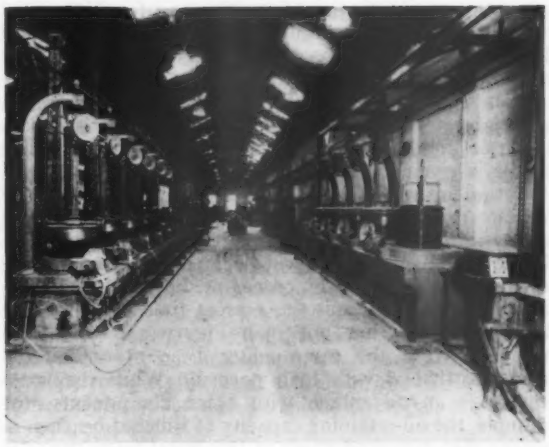
Speedwell Wire Company Limited

Fig. 2.—A complete steel wire drawing plant. At the far end are continuous non-slip waffle type machines handling rod as feed, and supplying medium-size wire machines in the centre, which in turn feed the finishing machines nearest the camera

done by passing the end betweeen a pair of steel rolls, In multiple die machines these rolls are generally incorporated as part of the machine and this makes for rapid die threading.

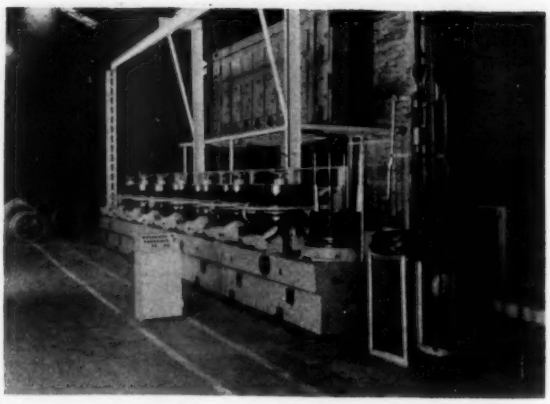
Ferrous wire

While many of the non-ferrous wires such as copper, aluminium and brasses may be fed to the drawing machines with only a little preliminary treatment, such as pickling to remove scale from the rolling process, followed by washing and drying, both iron and steel wire usually require a more elaborate treatment. In this case the wire drawer makes use of hot-rolled rod (Fig.1), varying in diameter according to the amount of cold-working to which it will be subjected. The rod is first cleaned by immersing it in hydrochloric or sulphuric acid to remove oxides. It is next sprayed with high-pressure water to eliminate oxide residues and acid; then placed in hot lime to neutralize any remaining acid. Finally, the rod is baked or "blued" in a specially-designed oven which circulates hot air freely around and between the rod and eliminates all moisture. This leaves the rod with a coating of lime, which will protect the metal for a limited time if it has to be stored before drawing, and the lime is considered to aid the passage of the metal through the dies. Where long lengths of wire are required, as in winding and haulage ropes, rods are welded together to give the length needed. Where any appreciable reduction has to take place in the dies, steel materials are subjected to a normalizing process or grain refining. This consists of heating the metal to a temperature exceeding the upper critical range, holding the temperature for a short time, and then cooling in air.



Speedwell Wire Company Limited

Fig. 3.—High-speed, non-stop drawing machines handling steel wire and having finishing speeds up to 2000 fpm



Speedwell Wire Company Limited

Fig. 4.—A Barron & Crowther non-stop 7-die machine with air- and water-cooled double blocks, handling rod of 232 mils and reducing to 80 mils at 75 tons per sq in. at 1129 fpm

Further cleaning of the metal is then necessary before drawing can be resumed. Normalizing of the metal with its resultant fine-grain structure permits of extensive cold-working without the loss of much ductility. It is possible to draw some steel materials up to tensile strengths exceeding 160 tons per sq in. and still retain a high degree of ductility.

One of the largest outlets for steel wire is in the fabrication of ropes, and as the efficiency of the latter depends upon the quality of wire which has gone into them, the ropemakers regard the drawing technique as of prime importance, and they usually control the drawing of the wire. Amongst the British ropemakers' plants, a typical example is that of the Speedwell Wire Company Limited, which supplies wire to its associated company, Martin, Black and Company (Wire Ropes) Limited, the two concerns occupying adjoining sites at Coatbridge. At the Speedwell works the steel rod is delivered by road and rail, being handled by overhead cranes which may place it in store or directly into process; the first steps in the latter being pickling for some types of rod, and preliminary heat treatment for others. After acid-pickling and washing, high-carbon rods for improved plough steel wire, and also rods for high-speed drawing, are bonderized whereby a thin film of chemical is attached to the surface of the rod. For lower grades of steel, lime only is employed. The pickling acid is stored outside the building and is fed as required, by gravity, to the pickling tanks via a measuring unit.

Various types of drawing machines are in use (Figs 2 & 3) including a multiple machine drawing slowly in thick plough steel down to 160 mils, with a breaking strain of 130 tons per square inch. Some of the Barron and Crowther high-speed, non-stop machines operate at 2,000 fpm, while others, handling the finer diameters, run at 3,500 fpm, reducing wire from 18 mils to 10 mils, at 110/120 tons per square inch. It is said that these latter machines have proved very satisfactory and more of them are to be acquired to handle wire from 50 mils to 18 mils, For handling the rod itself, and drawing from 232 mils down to 80 mils, at 75 tons per square inch, a new Barron and Crowther unit (Fig. 4) has been installed. This is a 7-die machine with 22-in. double blocks, which are air- and water-cooled, the drawing speed being 1,129 fpm. As the wire leaves each machine in this plant it is collected on spools ready for transfer to the adjacent ropery. Since the two plants operate in conjunction with each other, the drawing machines can be engaged on wire that is required immediately afterwards in the ropery, and it can be wound on the appropriate spools for the ropery. Thus much time is saved in not having to re-wind for the stranding machines. Further, to make a particular rope, the required amount of wire can be supplied by the drawing plant without any wastage, and the amount needed can be put on the spools direct from the drawing machines.

The processes of patenting, pickling, washing and boraxing are accomplished by the aid of in-line units (Fig. 5) and each unit may be employed alternatively for patenting, pickling, washing, fluxing and galvanizing. The ropery was extended in 1957 and to supply the increased quantity of wire, the drawing plant has been enlarged by adding additional drawing units, together with an additional 50-ft furnace, with in-line pickling, washing and coating plant to accompany it. To cut out some of the pickling that would otherwise be needed, a series of scale-breakers has been installed, and these are fitted to the inlet side of the machines doing the preliminary drafts. These scale-breakers are applied particularly to rod of composition up to 0·70% carbon.

Die construction

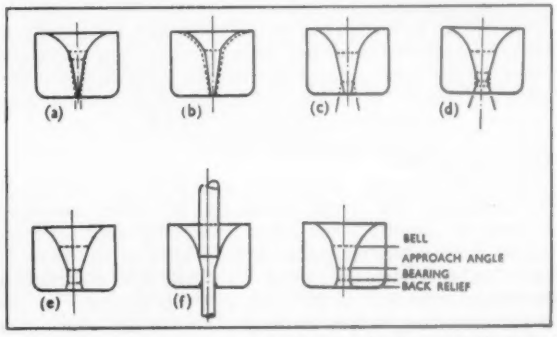
The dies through which the wire is drawn to reduce its diameter are made generally of either tungsten carbide or diamond; the latter being employed for finer gauge wire, while tungsten carbide handles the bulk of the thicker industrial wires. A third die material is hardened steel but as this has not the hardness of the other materials, it does not find extensive use in accurate wire drawing but is still used for non-ferrous metal strip (Fig. 6). Tungsten carbide, while not as hard as diamond is much cheaper and if properly handled has a long life. Its life is prolonged by the fact that a die of given diameter can be reshaped to a larger diameter after wear has taken place; so that a die of initially small size and handling thin wire, can be afterwards adjusted to handle medium wire, and finally the rod of 250 mils or a little less. Tungsten carbide is well known as a cutting medium and since the raw material is in powder form, it can be readily shaped to any contour. Therefore the production of dies in this material is not difficult. The strength of the sintered product is high in compression

Speedwell Wire Company Limited

Fig. 5.—Pickling, heat-treating and coating department, all operated on the in-line system

British Insulated Callender's Cables Limited

Fig. 6.—Drawing of copper strip to final dimensions through a steel die



British Insulated Callender's Cables Limited

Fig. 7.—Stages in making a tungsten carbide die from a roughly-cored pellet

but low in tensile strength so that, in common with the diamond, the die has to be encased in a strong steel housing to provide the necessary strength. During the past few years radioisotopes have been used to record wear taking place in the carbide dies. The wear of the carbide and the distribution of die particles on the drawn wire can be recorded by irradiating the die and passing the wire through a detecting apparatus.

A hole can be made through tungsten carbide much easier than it can in a diamond, for with the latter it is a lengthy operation involving the use of a high-speed rotating steel point operating in a paste of oil and diamond dust, the latter being the cutting medium. As carbide is a manufactured product, however, an aperture slightly smaller than the finished size needed is drilled in the material before sintering and while the latter is still in a friable condition. After sintering, the final accurate profile is given to the aperture by the use of a shaped steel tool operating in oil and either diamond dust or boron carbide. The various stages in carbide die finishing are outlined in Fig 7, a to e, Fig. 7 f, illustrating the degree of reduction that will occur in the die, and the last diagram showing the names of die parts. Tungsten carbide dies as made at the present time are of a very dense structure, but not many years ago dies were produced from the same material as other sintered products, that is with high porosity. While the latter feature is an advantage with some components—for example, the oil-retaining capacity of sintered bearings—porous dies absorbed some of the metal from the wire and metallic particles so absorbed gradually broke up the sintered structure, so rendering the die useless. The strong steel housing for a tungsten carbide die, water-cooled, and operating on steel wire, is seen in Fig. 8, while (Fig. 9) depicts the entire machine fitted with a number of these die-boxes.

Diamond dies

Generally speaking, diamond dies are used for wire below 100 mils diameter. These dies have a life from 2 to 2½ times that of a tungsten carbide die on the same service. An example of wire that is worked through diamond dies is tungsten for electric lamp filaments. Here great accuracy of diameter is necessary so that the lampmaker can calculate his voltage and wattage correctly. For less expensive wire and where gauge accuracy is not so important, the carbide die may be employed for wire as thin as 30 mils, but where accuracy of diameter is required, the carbide die is not commonly used for wire of less than 80 mils. The diamond die is more costly than the carbide counterpart firstly because a flawless high quality stone has to be used; secondly because the diamond has to be drilled and shaped, and this is a very slow job even with the latest machines. The contour or profile of the aperture is much the same as for carbide dies, and in both types it is only the inner portion of the aperture that gives the wire its diameter. Contour details vary, however, with the type of metal to be drawn. For relatively soft metals such as copper and aluminium, the funnel-shaped orifice of the die is approximately the same on both sides of the die, with the narrowest part of the hole in the centre. For steel and other hard wires, the funnel shape is greater at the inlet side than at the outlet, and the narrowest part of the aperture is not in the centre but is nearer the outlet side.

While it is a recognized practice to repolish or re-condition dies, the die aperture when reconditioned is always larger than it was originally. This sometimes leads to the use of diamond dies for wire that could be handled equally well by carbide dies; for when the die is of no further use for its original purpose, the owner finds it more profitable to use it as a die than discard it as scrap. Many diamond dies, however, do not reach the reconditioning stage, for there are several service factors which tend to shorten their lives. One of these is vibration—common to most drawing machines—which may produce minute invisible cracks in the stone structure.

Ultimately the cracks may extend along the natural cleavage planes, and rupture of the stone may occur. The latter can also occur by the presence of a few grains of hard heterogeneous matter embedded in the wire passing into the die; this sometimes damages the stone, but more frequently it breaks the wire. Wear on the stone is likewise increased by attempting too big a reduction in one draft; it is generally more economical to use an adequate number of dies in drawing from one given diameter to another. Too many dies for a given reduction are, however, of no advantage for this leads to abrasion of the dies as the wire passes through. On some machines, operating with carbide dies, the final die is a diamond which has an aperture the same as the die immediately preceding it; the diamond is therefore doing no reducing but is merely acting as a gauge to the dies doing the reducing. In such a position the diamond die wears as quickly, through abrasion, as though it were in the reduction line.

The British Diamond Die Federation has recently carried out investigations into the performance of diamond dies employed in normal drawing operations in various British works and some of the results obtained are as follows. There is a large variation in the amount of wire drawn to fixed tolerances by dies of the same maker. There are no appreciable differences between different makes of die, and die-life is generally determined by too large ovality developing in the wire drawn. Regular plotting of the ovality of wires produced by each die might provide a useful guide to performance. The Federation also recommends that purchasers might with advantage buy dies within limits 0·00005 in. and nil of the nominal size and then carefully polish to size for maximum commercial service.

Drawing speeds

In drawing rod or wire through one or more dies there is theoretically no change in volume, while in practice the change is not appreciable. The relation between the rod or wire before and after drawing may be expressed as follows:

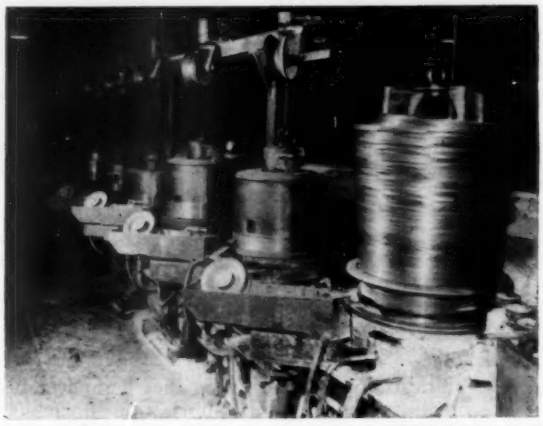
$$L_a/L_b = C_b/C_a = D_b^2/D_a^2$$

where L=length; C=cross-section; D=diameter; a=before reduction; b=after reduction.

A soft wire such as aluminium or copper can be drawn at higher speeds than harder materials such as steel or tungsten, and with a given metal, the smaller the gauge of the wire the greater may be the drawing speed. In producing wire from rod, the first series of dies is responsible for a fairly big reduction ratio and the wire speed is much less than it is in the final drawing machines. Since there is little, if any, loss in total volume of metal being drawn, it will be obvious that wire leaves a multiple drawing machine at a much higher speed than that at which it enters; so that each successive capstan or block in the machine has to travel at a faster speed than the one in front of it in order to maintain tension on the wire. The speeds of the capstans are, therefore, directly related to the die apertures and the amount of reduction taking place in the dies. For steel wires the amount of elongation which occurs in one die is usually between 8% and 10%. A much greater elongation is possible with softer wires and may be as high as 25% in one draft. Hard wires such as tungsten are heated before drawing and the reduction per draft is about 15%. The actual speed at which the wire traverses the die varies with wire diameter. For example, 250-mils copper rod is fed to the first die at a speed of about 1·7 fps, or approximately 100 fpm; 40-mil copper wire emerges at the rate of about 3,600

British Ropes Limited

Fig. 8.—Close-up of water-cooled wire drawing die box for steel wire

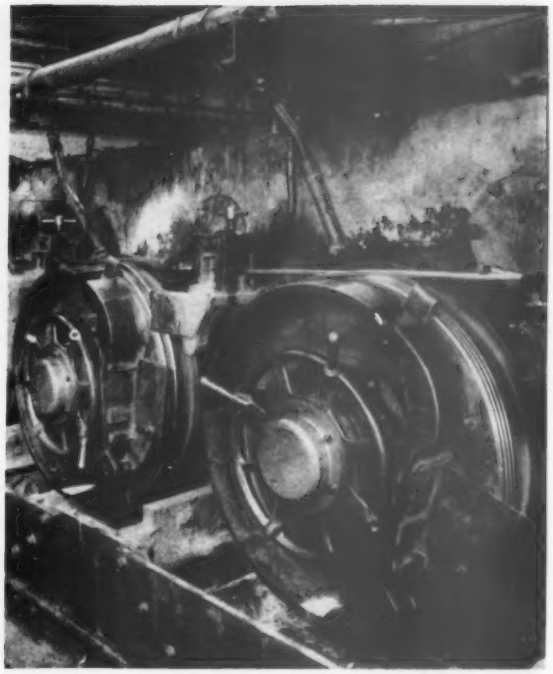


British Ropes Limited

Fig. 9.—Steel wire being drawn through a series of tungsten carbide dies; die boxes are in the forefront

British Insulated Callender's Cables Limited

Fig. 10.—Group of machines for drawing non-ferrous wire to sizes 1·6 mils to 4·8 mils, at a finishing speed of 4000 fpm. Each machine has four drawing capstans or cones



British Insulated Callender's Cables Limited

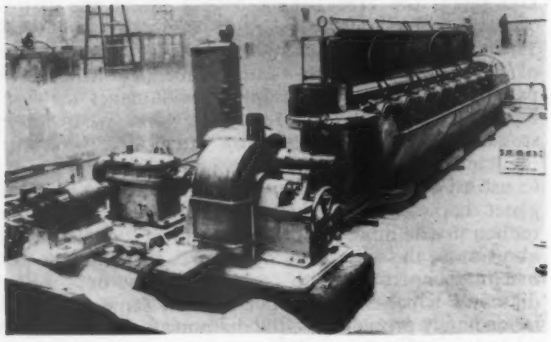
Fig. 11.—Trolley wire drawing. Round wire is drawn through dies containing a cutting projection to produce a groove in the wire

fpm; while smaller gauges are finished at about 4,000 fpm (Fig. 10).

Lubrication

The lubrication of wire-drawing dies has never been so thoroughly investigated as the lubrication of machinery in general, and each wire drawer has tended to maintain a certain amount of secrecy as to what is used for this purpose. The British Iron and Steel Research Association has investigated the problem of die lubrication and they are of the opinion that present industrial methods of minimizing die-friction are unsatisfactory, as the wear on the dies is often excessive. The lubricant may also be difficult to remove from the wire and may interfere with finishing processes such as heat-treating and coating. It is often claimed that lime on the surface of ferrous wires acts as a mechanical carrier of a solid lubricant. The Association carried out tests to determine whether lime has any useful function in lubrication. Results indicate that if either calcium stearate (a metallic soap) or stearic acid (a fatty acid) is deposited directly on to the wire it is more effective in reducing the die load than if it is applied after the wire has been limed or roughened. Stearic acid forms a thicker and more tenacious film on the wire than calcium stearate and thus gives smoother drawing. The modern tendency is to regard lime on the wire as an abrasive agent and not a lubricant carrier. One of the functions of lime is to burnish the steel and help to produce bright drawn wire.

The influence of various lubricants on the drawing of copper wire was discussed at a symposium held by the Australian Institute of Metals[2] with particular reference to the avoidance of overheating. Tests suggest that the most satisfactory procedure is to use a soap emulsion with high drawing speeds and light individual reductions;



Sir James Farmer Norton & Co. Limited

Fig. 12.—A 9-die tandem machine for drawing copper wire from rod at 250 mils down to 48 mils at a finishing speed of 3000 fpm

the object being to keep the temperature of the copper low. It has been suggested[3] that severe die wear which may occur in the high-speed drawing of wire through tungsten carbide or diamond dies would be much reduced if true hydro-dynamic lubrication could be provided, and that this could be done by supplying oil to the entry of the die at a pressure comparable with the yield stress of the wire.

This latter idea appears to be the most promising, for in order to maintain a film of lubricant between die and metal rushing past it, it would be necessary to operate the die boxes under pressure by adopting a pressure-lubricating system as is done for many types of machines. The problem differs from conventional lubrication practices, for in the latter it is the same area of metal that has to be lubricated and as long as a film is maintained on that relatively small area, possibly by the use of extreme-pressure lucribants, all is well. In wire drawing, however, a mile of wire has to be lubricated every two minutes or so, and another mile during the next two minutes, and so on. The problems associated with dies would be solved if the new idea of "hot stretching" comes into extensive use, for in this process the wire is drawn out after heating and without the use of dies. Experiments show that bright-drawn mild steel wire can be reduced satisfactorily by as much as 50% and stainless steel wire by about 40%; the wire being heated to between 800° and 1,000°C. at the time of drawing. It would appear, however, that such a technique could not impart any specific diameter to the wire and this would seriously limit its applications.

In normal types of wire drawing the aperture in the die is, or should be, perfectly round. There are, however, a few applications in which the die is not used for reducing but for cutting, in order to impart a given profile to the wire. An example is the drawing of trolley wire (Fig. 11) which is made by drawing round wire through two or more tungsten carbide dies having a small projection in the otherwise spherical aperture. The projection acts as a cutting tool and each successive die increases the depth of groove in the wire. In this work no reduction in wire diameter occurs apart from the loss of metal due to the formation of the groove.

Drawing machines

While there are many types of drawing machines, the preliminary reduction of rod is commonly done on a tandem machine (Fig. 12). These machines may be the only units required if the final product is to be relatively thick wire, as used in concrete, fencing, packing, etc. A

Sir James Farmer Norton & Company Limited

Fig. 13.—An 8-die concentric drawing machine; each drawing block is powered by a 25-hp motor

Electric Resistance Furnace Company Limited

Fig. 14.—An installation for continuous strand annealing of fine stainless steel wire

tandem machine is, therefore, a preliminary unit for finer wires as used in cables, while it is also a complete production unit for the thicker gauges. On softer materials, a 9-die unit will reduce to 48 mils from 250 mils, with a finishing speed of 3,000 fpm. The reduction of steel wire through the same machine would be about 2,000 fpm. A tandem machine is made up of a number of revolving drums or capstans, successive drums rotating at increased speed in accordance with the amount of elongation taking place in the dies. The capstans may be driven individually, one motor to each drum, or the whole unit may be handled by one larger motor at the end of the machine, operating each capstan through gearing. Collection of wire from the machine is by reels or spools and one of the most important measures in recent years has been the standardization of reel sizes throughout the industry. Where it is not desirable to collect the wire from the machine direct on to reels, use may be made of a block specially designed for this work. The latter may be regarded as an ingenious method of coiling wire. As the wire leaves the machine it is wound on to the base of a tapered block, the taper allowing each successive lap to displace the previous one by pressing it further up the taper. The diameter which the block offers to the incoming wire is thus a constant, as is also the lineal speed of wire approaching the block. At the start of a second lap, when one wire has to be wound on another, a device comes into operation to slow down the rotating block to maintain the same lineal speed. These devices are of different types, including fluid flywheel couplings, plate clutches, mechanical variable

Electric Resistance Furnace Company Limited

Fig. 15.—Feed end of a continuous wire patenting furnace, with furnace control equipment on the right

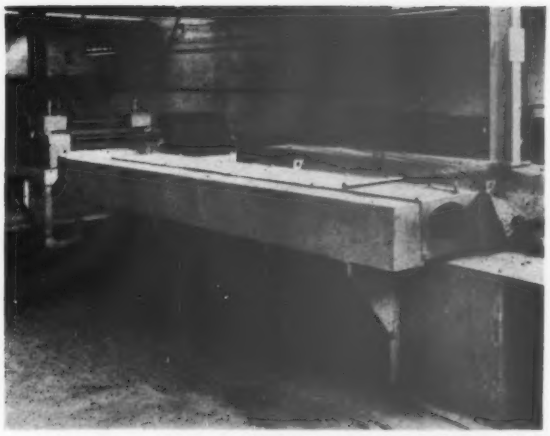
couplings, or hydraulic couplings, which come into operation at the completion of each row of winding and slow down the block at the required speed for the next row.

The multiple-die concentric machine (Fig. 13) is also a versatile unit and incorporates a non-slip feature. In this, no slip is possible, due to the coil-friction of wire. A certain amount of wire is drawn on the block, and a slightly less amount taken off which results in a small accumulation of wire on the blocks, so that a particular block has always some wire in stock to feed the next one. If the stock of wire on any block becomes more than is needed, any block can be stopped by the operator, which automatically arrests all previous blocks, while the forward blocks continue to take the surplus wire. A feature of such a machine is the absence of overhead gear, which gear tends to become dangerous at high speeds. Cooling is also improved by the fact that there is an accumulation of wire on each block which permits of cooling down before the next die is approached. It is possible to continue drawing during stripping and for this purpose the end block is used as a winder. Average speeds on these machines are 2,000 fpm on 160 mils steel wire and reducing to 48 mils; or with steel wire feed of 212 mils, reducing to 64 mils, 1,500 fpm; or with copper feed of 250 mils, down to 64 mils, 3,000 fpm.

Heat treatment

In a wire drawing plant the heat treatment units may be regarded as the nursing service without which the wire could not undergo the severe cold working entailed in pulling it through the dies. The main object of heat treatment between draws is to maintain the ductility of the metal. With some types of wire there is a need for bright, as distinct from clean annealing and this means the use of a controlled atmosphere. With the demand for better quality wire, the heat treatment plant has gained in importance in recent years.

A typical continuous strand furnace for bright annealing (Fig. 14) is designed to keep pace with the speed of the drawing machines and the wire may be run straight from reels through small-bore tubes which extend through an electric resistance furnace; the tension of the wire being maintained by winding frames sited adjacent to the cooling chamber exit. Such a furnace may be used for many different types of wire, copper, phosphor bronze,



Electric Resistance Furnace Company Limited

Fig. 16.—Lead quenching bath for handling wire after patenting

nickel-chrome alloy wire, plain carbon and alloy steels, etc. The type of controlled atmosphere depends on the metal under treatment, but in each case only small volumes of inert gas are needed for use in small-bore tubes. In the case of non-ferrous metals, up to 45 wires can be run simultaneously through the furnace; ferrous metals being thicker, cannot be handled in quite such large numbers, and about 10 heavy gauge steel wires can be treated at once.

The process of continuous wire patenting is applied to medium- and high-carbon steel wires, for the double purpose of increasing their capacity for cold work in drawing, and producing in the drawn wire the most desirable properties. It consists of heating the wire in continuous strands to a temperature well above the upper critical temperature, followed by cooling in air or a bath of molten lead or salt held at a temperature depending upon the carbon content of the steel and the properties required. The type of quench is usually determined by the thickness of the wire and properties needed in the finished product, but the object is to attain the so-called sorbitic structure, with a large but controlled grain size. To do this, the patenting furnace must provide quick heating followed by soaking to impart correct amount of grain growth, with the wire leaving the furnace at the right quenching temperature. A furnace for this work is, therefore, zoned along its length, so that the wire attains the required temperature at half the furnace length and is soaked for the remainder. Tubes as used in strand annealing are not necessary with the thicker wires handled in patenting, and the wires are spaced and controlled by tensioning gear (Fig. 15) at the end of the unit. It is common practice to include a gas screen at the inlet and to reduce air ingress, but the present tendency is to use a prepared atmosphere from a town's gas generator. This is particularly so where galvanizing follows patenting, and for this reason the modern patenting furnace is built as a gas-tight unit.

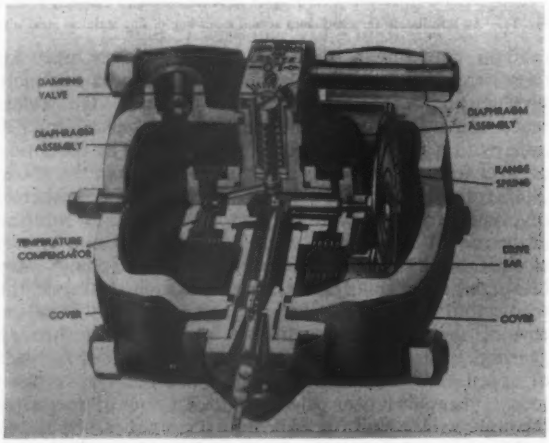
Working in conjunction with the patenting furnace is a lead quenching bath (Fig. 16) in which heating is done by electric immersion heaters. It is necessary to maintain the bath at quenching temperature, about 500°C., which means compensating for the heat carried over with the work. This is achieved by a built-in forced air cooling system, in which cooling tubes positioned between the heating elements are provided with a damper to control the air flow from a blower. Both blower and heater are wired to the temperature control instrument, and through the medium of high and low contacts, one or the other is brought into action when the temperature fluctuates only 5°C from the control setting. These accurate quenching temperatures enable the wire to retain the desired properties ready for further drawing; or when treating finished wire, the product has the required mechanical properties for the purpose in view. When drawing operations are complete and the wire is to be galvanized, a preliminary annealing or patenting process is necessary before the wire can be efficiently galvanized. Winding and haulage ropes for mines are made up of wires that have been so treated.

References

(1) Anon. *Wire Industry*, 1957. Sept. 861.
(2) "Theory & Practice of Wire Drawing", 1953. Australian Institute of Metals Melbourne.
(3) D. G. Christopherson, *Chart. Mech. Engin.*, 1955. 1, 143.

Measuring Differential Water Pressure by Diaphragm Meter

A mercuryless meter to measure a range of differential pressures from 20 to 200 in. of water at static pressures up to 2000 psi has recently been developed by Foxboro-Yoxall Ltd., Redhill, Surrey. The illustration shows the inner construction of the chamber assembly of the new meter. For the measurement of differential pressure, a flexible diaphragm assembly is used having preformed discs welded by a special process and each shaped to nest into the adjacent disc and spaced by welding to a spacing ring. Excess pressure in either chamber will compress the diaphragm assembly until each pair of discs is nested and the spacing rings have contracted to form a metal to metal stop. This assembly is claimed to have greater flexibility and higher sensitivity per unit length, with less spring rate than any spun or hydraulically formed bellows for equivalent service.



Interior view of the FOXBORO-YOXALL mercuryless diaphragm meter, Type 37

The drive unit is solidly made with a flexible connexion between the diaphragm assembly and the pen lever. The fulcrum is formed of two similar flexures and the seal is a flexible bellows capable of withstanding pressures 50% above the meter rating. This drive transmits the smallest measurement changes to the pen with extreme accuracy. Temperature compensation for all differential ranges and full range damping which is adjustable under pressure are incorporated.

Developing the Oxygen Process for Steel Melting

The use of oxygen in the open hearth furnace gives a greatly increased output, but it raises new problems. How some of these have been tackled in one installation is described

A SUBSTANTIAL increase in steel output compared with normal furnaces for approximately the same cost per ingot ton of steel has been achieved by the use of oxygen in a specially-adapted 350-ton tilting open hearth furnace at the Scunthorpe works of Appleby-Frodingham Steel Company, a branch of The United Steel Companies Limited. During a four-week period this year, the Ajax furnace as it is called, achieved a record output of 19,263 tons of steel, making over 5000 tons per week in three of the four weeks. This is believed to be the highest output ever attained by an open hearth furnace in Britain.

Experiments in the oxygen lancing of open hearth furnaces have been carried out at Appleby-Frodingham since 1950 and have led to some exceptionally high rates of production. The higher outputs were partly offset, however, by such factors as severe roof wear and repeated blocking of the furnace chequers by dust. It became apparent that very considerable changes in furnace design and structure would be necessary in order to develop an efficient oxygen process and that this could only be proved by full-scale trials. The demand for ingots to supply the company's rolling mills dictated a stringent time schedule for the reconstruction, and it was in fact accomplished in 27 days. Trials began on the modified furnace—which was given the code name of Ajax to distinguish it from conventional furnaces—in February of this year, and over 100,000 tons of steel have since been produced by the process.

At the chimney end of the furnace, the first problem to consider was that of gas cleaning in order to deal with the increased amount of suspended matter carried out by the waste gases while using oxygen and to avoid excessive atmospheric pollution. On grounds of economy in capital cost and the very low air infiltration expected, it was decided to install a dust removal plant with a capacity much below that for an open hearth furnace of comparable production potential. Available evidence indicated the bag filter type as the one most suitable for this experimental furnace.

In order to minimize the volume of gas to be cleaned, the whole structure of ports, uptakes, slag pockets, regenerators and flues in the reconstructed portion of the furnace was completely encased in steel up to the junction of the main stack flue in the valve arch. Flexible packing joints are provided at every junction and at every inspection or cleaning hole.

The Ajax furnace regenerators are much smaller than those on a conventional furnace so that they can be blown easily and quickly with compressed air lances at frequent intervals. The height of the chequer filling is similar, but the maximum gas flow rate more nearly resembles that of a blast furnace stove than an open hearth regenerator. The small cross-sectional area of the regenerator has an additional advantage when using oxygenated air to assist combustion in that no added oxygen is lost through the structural brickwork.

The area of the offtake from the furnace hearth was also considerably reduced for four main reasons: (1) to lift the furnace end bank as high as possible in order to minimize slag overflow when sponging; (2) to minimize the overall weight of the offtake and uptakes so that they can be removed by crane and quickly changed; (3) to minimize the cost of relining with 'all-basic' refractory bricks, and (4) because the gas volume leaving the hearth during most of the operating time is much below that of the normal open hearth furnace.

Reducing the area of the offtake enabled two separate slag pocket and regenerator systems to be installed at each end of the furnace in the same space normally required by one set of systems. This means that all repairs below the furnace stage can take place while melting is in progress, so that a general repair takes only the time needed to rebuild the furnace hearth itself. In the slag pockets, it means cooler working conditions for the men who can do their job during the normal working day instead of on shifts.

"All-basic" bricks are used in the lining of the ports, uptakes, slag pockets and the upper half of the regenerator chambers and chequers of the Ajax furnace. Both the slag pockets and regerator chambers are cylindrical in cross-section with a view to simplicity of construction, strength of design and minimum volume of basic brickwork. To conserve heat and protect the steel structure insulation is used from the ports to the chimney flue, consisting of 1 in. Dextramite slabs on the steel shell, then 4 in. hard insulating firebrick with 13½ in. basic end arch bricks as the working lining.

Machine-faced chills are employed to ensure a tight junction between the tilting hearth and the port, the port itself being on wheels with a water seal connexion to the uptake. Electrically-controlled compressed air cylinders ensure the best possible contact between the chills. The oxygen lance is introduced to the furnace through the port at an angle of 27°. The lance is fixed to a movable, motor-driven carriage and withdrawn at each reversal of gas and air; it can be changed in 35 min.

Coke oven gas burners are inserted in each corner of the tilting portion of the hearth instead of through the port ends: this helps both to avoid any enlargement of the port and the addition of more trailing flexes. Oxygen can be used to assist combustion when required and is fed into the burners through two holes just below each gas inlet. For rapid melting, this placing is not very efficient but is quite adequate for holding the bath temperature at the end of refining, when burning in dolomite or heating up scrap.

The thermal input of the furnace is low by design and, without oxygen, it would produce steel at probably no more than 10 to 12 tons per hour compared with 25 to 35 tons per hour when on oxygen.

Comprehensive controls and instrumentation are provided, all valves being centrally operated by electric

pushbuttons to achieve the rapid manipulation which is essential to the successful operation of the process. The controls enable oxygen to be used in three ways: through the water-cooled lances, through the coke oven gas burners or through the regenerators as an addition to the air. The latter is possible because of the freedom from infiltration.

Experience gained during several months of continuous operation of the Ajax furnace has proved the value of the process in raising steel output without incurring heavy capital expenditure and at no greater ingot cost. But there are still many problems to be solved. Losses of iron in the slag, for example, are higher than in the normal Appleby-Frodingham practice. It still remains to be discovered how these losses can be reduced without slowing down the process: the furnace taps every 7 to 8 hr compared with the normal practice of 14 to 16 hr and to retard it would only increase costs without a comparable saving in iron. An improvement in roof life is also sought, although the extra costs here are balanced by savings in 'below stage' refractories. Finally, there is further work to be done on the life of the oxygen lance and the best gas velocity when lancing. The Ajax furnace is now the largest steel producing unit at Appleby-Frodingham and, in view of the rapid progress already made with its development, it seems unlikely that any of these problems will be found to be incapable of solution.

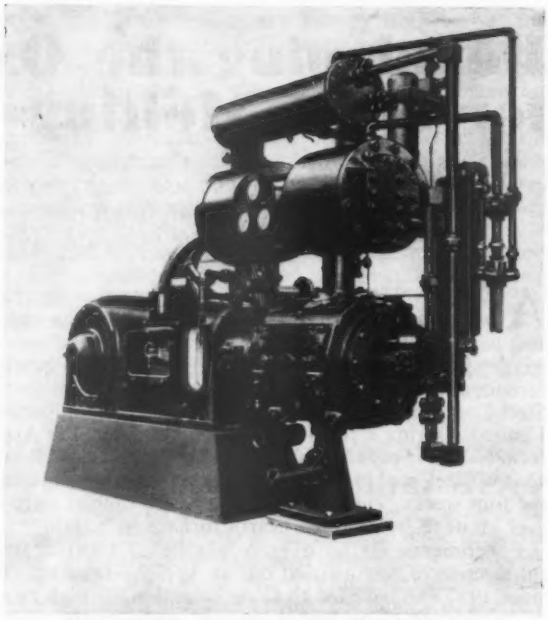
Three-stage Air Compressor

The new three-stage straight line compressors introduced by the Consolidated Pneumatic Tool Company of 232 Dawes Road, London SW6, are designed for the continuous compression of air or other gases to pressures of up to 1500 psi with a free air delivery of 242 cfm at that pressure. For operating periods of not more than eight hours, the compressors may be run to give 238 cfm at 2000 psi.

In principle the new TCB.3 compressor is a further logical development of the class T design, using a double-acting low pressure stage followed by a single acting, opposed second and third high pressure stages.

The frame, common to other units in this class, carries a Timken taper roller bearing supported shaft, two sets of bearings being used to equalize end thrust. A wedge adjusted connecting rod of forked end construction transmits the drive to a solid box-type crosshead, which overtravels its guides by half its length, the crosshead face being a ground fit in the bore of the guide and grooved for effective lubrication.

In the compression section, a double-acting first stage piston interposed between second and third stage pistons, acting in opposite directions, gives an almost equally divided load between forward and return strokes. Air is admitted at atmospheric pressure through Simplate valves to the two compression chambers formed on each side of the piston. Low pressure air from the cylinder is then passed by further Simplate valve to multipass tubular intercoolers carried above the compressor. Water passes through the cooler in opposition to the direction of the air flow, the coldest water thus being in contact with the coolest air as it leaves. From the intercooler, air passes to the second stage, single-acting cylinder, this cylinder being located at the crank end. From this cylinder it is further cooled in the second stage multi-pass intercooler tubes before passing to the separator for removal of condensed moisture. The third stage cylinder, of heat treated forged steel at the outer end completes the compression cycle.



The Consolidated Pneumatic three-stage class TCB.3 compressor

A hollow reinforced one-piece casting is used for the first and second stage piston, the third stage piston comprising a hardened steel self-aligning plunger. Lubrication of the cylinder is by a force feed lubricator, with separate feeds to the first, second and third stages. This force feed is positively driven from the crosshead, automatically supplying a visible regulated quantity of oil to each cylinder.

Metallic packings are fitted where the piston rod passes through the second stage cylinder head and steel wipers located in the frame prevent oil from being carried out of the crankcase by the piston rod.

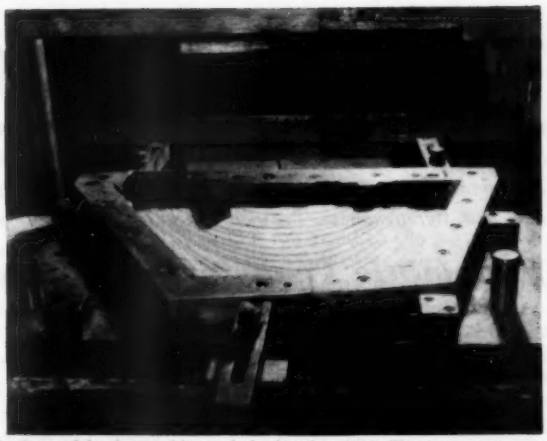
Coloured Metals can be Deep Drawn

A new process for colouring and protecting metals now being developed by the Alloy and Metals Department Union Carbide International Company, 30 East 42nd Street, New York 17, N.Y., U.S.A. has the advantage that metals so treated can be severely formed without impairing the applied surface. At the present time only black colouring is being produced commercially, but ultimately, a range of colours for use on aluminium, plain carbon steels, stainless steels, and other metals will be available.

Basically, the Permyron process as it is termed involves applying the proper pigment by spraying or roller coating, to specially prepared surfaces with subsequent processing under controlled conditions of temperature and atmosphere. The resultant colouring is durable, and chemically and physically resistant.

To date, much of the work on the Permyron process has been done with stainless steels, the black colouring having a low light reflectivity and a pleasing appearance without glare. It is flexible, and is not subject to cracking caused by expansion and contraction and stainless sheet can be deep drawn and bent after colouring without cracking and crazing; for example a specimen was tested to 50% elongation before any apparent damage to the coloured surface.

Pieces of glass fibre cloth cut into the 50 different patterns required to make the Regulus II guided missile nose trimmer are laid out on screens to dry before being placed in presses and heated. Contours of the finished trimmer are achieved by varying



the shapes of the pieces making up the laminated sandwich. The picture on the right shows half the pieces assembled in the press form. Largest pieces are placed on the bottom, tapering to the smallest in the centre and then in inverse order so that the largest pieces are on top of the sandwich

Glass Fibre Moulded Parts for Missiles

Accurately faired components made by building up from a large number of cut pieces of glass cloth

THE Regulus II guided missile of the U.S. Navy has nose control trimmers which reduce the landing speed of the missile by 30 mph and thus enable it to be kept under more accurate radio control. The trimmers are tapered in three directions and are built up from layers of glass fibre material.

The problem was to build the two-foot movable surfaces for the missile's nose with material that would not affect radio transmissions used to control the missile in flight. This ruled out metal trimmers. Machined glass fibre parts could not be used because exposed edges of the cloth would split into layers in the supersonic speeds of the missile. The problem was solved by the use of a 150-ton press and 320°F temperatures to produce the steerable trimmers, which act like aircraft elevators but are located in the missile's nose.

Each trimmer has knife edges on three sides and tapers from 1 in. thickness along the side next to the missile's skin. The thickest part contains 150 layers of glass fibre and the edges only six. To provide the smooth aerodynamic tapering required, 50 different patterns were used to cut the glass fibre cloth so that, when assembled and bonded, it would produce the proper shape.

The trimmers are recessed on the thick inboard side to take steel forgings and magnesium clamps used to link the two vanes together and move them up or down in flight. Patterns were cut in the glass fibre cloth when it was in the soft stage. Then the patterns were pre-cured to dry out excess solvent and moisture.

The largest patterns were laid in the bottom half of the die used to press them together. These tapered to the smallest patterns in the middle, then built up again to the largest on top of the pile. The dies then were pressed together and heated to 200°F to warm up the resin and allow some of the gas between layers to vent.

After a half hour, the temperature was raised to 320°F and full pressure of 150 tons applied for two and a half hours to permit the rest of the gas bubbles to escape and the resin to cure. The part was cooled under pressure and removed from the press. After inspection for flaws, it was placed in an oven at 180°F for four hours and an additional period at 350°F for post-curing. When this step was completed, the two trimmers were joined together with a steel casting "axle".

First experiments at manufacturing the trimmers saw them placed in a press exerting only 15 tons pressure. This did not effectively eliminate the gas bubbles between the layers of the cloth. By increasing the pressure ten-fold, it was found that the glass fibre, when heated, flows from the inch-thick portions of the pattern to the thin edges because the top die contacts the thicker part first. As the die comes down the glass fibre is forced back into correct position.

To prevent the leading edge of the trimmer from frilling in the heavy slipstream of flight, the final oversized three layers of cloth were lapped over the front edge. On the trailing edge, the cloth was tucked under the top layer to anchor it from the wind.

technique

devoted to the discussion of practical problems. Readers are invited to contribute items from their own experience in matters relating to design, manufacture and maintenance. Payment will be made for published contributions.

Any Questions? We welcome inquiries concerning difficulties arising out of our readers' general work, for treatment in the **technique** section. The full name and address of the writer (not necessarily for publication) must accompany each communication

Pneumatic Transfer Press Feed

A large electrical manufacturer has installed pneumatic transfer equipment by means of which commutators for vehicle engine starters are automatically transferred from a loading point into a riveting press, and then to the chuck of a rotary table reaming machine, at the rate of 500 an hour. Formerly an operator unloaded an air press and placed the commutators on a conveyor, while a second operator took them from the conveyor, loaded the hydraulic press, took the commutators off and placed them on the reamer.

With the new arrangement the commutators are taken from the air press, which slightly spreads the central sleeve, and hand loaded on a chain conveyor. They are then conveyed to a pneumatically operated feeding hand which places them into a hydraulic riveting press which completes the spreading operation.

A pair of rails picks up the commutators from the press and slides them into the chuck of the rotary table reaming machine. A cam on the rotary table ensures that the reaming machine chuck accepts a commutator at the correct moment.

The transfer equipment, which was designed and produced by The Hymatic Engineering Company Limited, of Redditch, Worcs., is pneumatically operated and electrically sequenced. The chain conveyor is operated by a pneumatic ram on a mechanical ratchet. Two pneumatic rams operate the feeding hand and the hydraulic press is triggered off by a pneumatic ram which presses the starting button.

A particularly difficult problem was the operation of the pick-up rails in the confined working space at the hydraulic press, where the commutators have to be lifted off the ejector pin and withdrawn before the rails can be lifted to slide them into the reaming machine chuck. This was overcome by the use of the pneumatic rams.

To avoid any possibility of the various feed motions getting out of step the cam on the reamer rotary table controls each feeding cycle separately, the hydraulic press acting as a slave. A small buffer stock of commutators may be built up on the chain conveyor, but they will be passed through the hydraulic press only at a rate at which the reamer can accept them.

The pneumatic transfer equipment, which operates on a mains supply of 80 psi, was designed so that it was unnecessary to move either the two presses or the reamer from their positions when they were manually loaded.

Accurately Bending a Long Channel-shaped Component

Bending material at right angles is usually accepted as being an easy operation and the inclusion of a double bend at each end of a cropped piece of plate as shown in Fig. 1 does not appear to complicate matters, and initial conclusions may tend to regard a single operation as being sufficient to produce the part. Other holes are pierced in addition to that depicted in this drawing, but basically the design calls for a channel-shaped detail with the $\frac{1}{2}$ in. dia hole in the centre of the sheet.

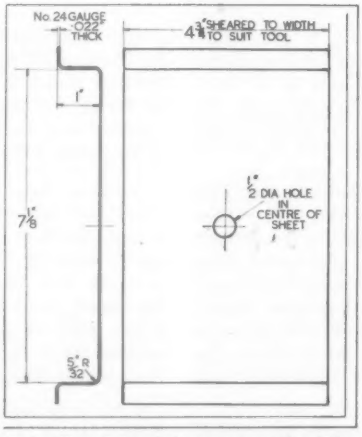


Fig 1.—Channel-shaped sheet component in which a central hole makes a useful location

There are three methods of producing a component of this nature—by forming the angles at a single press stroke, by V-bending each corner separately, and by bending both corners together as illustrated in Fig. 3. However, thought on the first two operations will reveal that both methods are not always desirable, and that the pressing of both corners in unison is preferable.

First, bending sheet metal at right angles is not an accurate way of carrying out the work because spring-back means that the bend is never a right angle when finished, and no possible alteration to the tool will give it the necessary degree of adjustment that will overcome this problem.

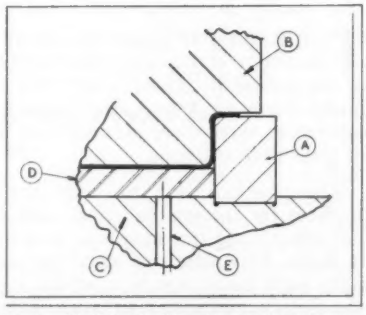


Fig. 2.—Method of bending when the sheet is pushed vertically down in the press tool—not an accurate way when a perfect right angle is required

Fig. 2 shows the two bends being made simultaneously in a tool of this description — the descending punch A strikes the sheet when the ejector-cum-pressure pad is in the raised position, thus the material is securely held while it descends in the die. The pad bottoms in the bolster when the final blow by the punch is made, and on again ascending the ejector lifts the component from the die. Immediately the workpiece clears the die the spring-back occurs and the right angle is thereby lost; such a condition persists whether a single or two bends are formed.

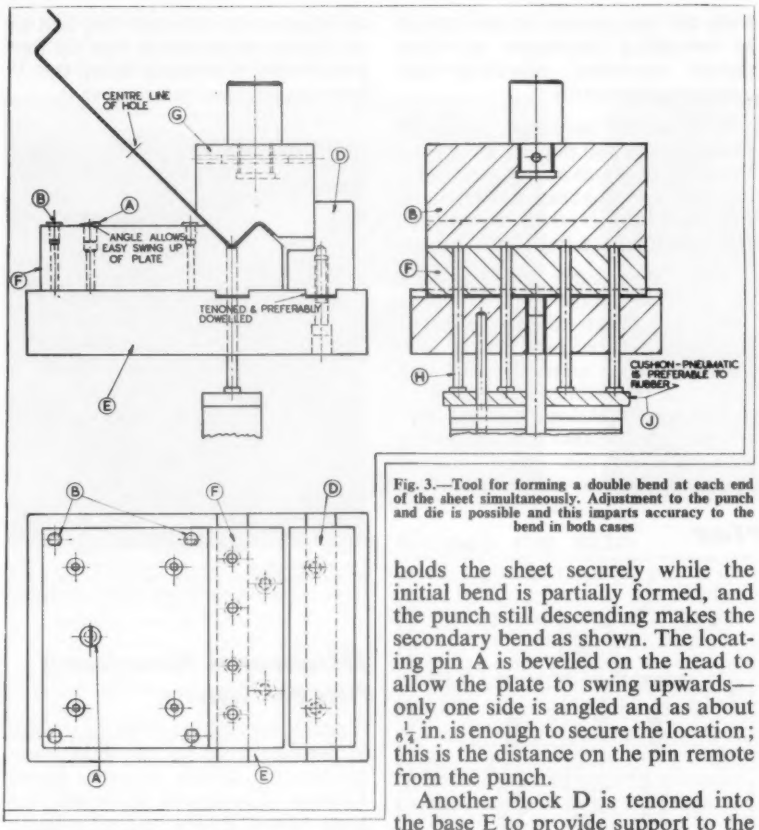


Fig. 3.—Tool for forming a double bend at each end of the sheet simultaneously. Adjustment to the punch and die is possible and this imparts accuracy to the bend in both cases

For very large work the process of bending each corner separately is often performed, and where the usual power press is not large enough the work is accomplished with the aid of the massive press brake. Each bend is made with a V-tool and separate settings are essential in order to achieve the correct position; the advantage here is that overbending is feasible to counteract the amount of spring back that may occur. This feature is a desirable one and the method is practised when bending wide sheets on this class of machine tool.

An alternative process and one which for the smaller component seen at Fig. 1 is the most profitable because it means less handling time is depicted in Fig. 3. The hole is initially pierced in the centre of the plate and this is useful because it automatically gives an accurate location for the two handlings which are necessary in this operation.

The sheet is placed on the pin A and between the pins B; the material laying across the V-die with the four holding pins C in the up position and flush with the die surface. On descending the punch G and pins H holds the sheet securely while the initial bend is partially formed, and the punch still descending makes the secondary bend as shown. The locating pin A is bevelled on the head to allow the plate to swing upwards—only one side is angled and as about $\frac{1}{16}$ in. is enough to secure the location; this is the distance on the pin remote from the punch.

Another block D is tenoned into the base E to provide support to the punch and actual contact is made before any part of the punch touches the sheet. This block prevents skidding—a condition which is normally limited to the slackness in the machine slides but one that can cause a malformed V unless efforts are made to overcome the problem.

Immediately one end is complete the detail is again placed on the locating pin and the opposite end formed in a like manner, and as both settings are carried out together an accurate dimension from the hole is forthcoming. Again the question of adjustment is feasible and the three angles are easily modified after the initial forming of a few trial pieces have shown the degree of error. Most designers overbend components of this type about 5° as this has proved to be the amount of error in similar cases, and some alteration to the component drawing figures is often desirable because if a large adjustment is needed there is always the great risk that subsequent surface grinding will remove the hardened skin from the punch and die and leave a soft area which is soon scored after completing a dozen or so items. For all tools in this category a hardened depth of about 0·03 in. is really essential to avoid the possibility of the surface 'picking up' and so making marks on the material.

Bending thick material, say greater than $\frac{1}{8}$ in., is not advisable with this method because of the problem of holding the sheet during the first stages of forming. A high pressure is in fact imparted to the parts but the area of each holding pin is insufficient to prevent movement of the sheet when bending this thick metal. An alternative design where the V is loaded for the complete length is preferable, and though this adds expense, generally this type of tool will hold material of this thickness.

While a rubber buffer will exert enough pressure when thin stock is bent, a pneumatic cushion is essential for the thicker varieties whether the latter is brass, aluminium or steel, and four pins arranged in the manner illustrated in the drawing are also necessary.

When these conditions are observed this method of V-bending is accurate and speedy.

Colour Aids Gear Production

The new £1m plant at Morris Motors Limited, Tractor & Transmissions Branch, Birmingham, which now houses the largest collection of highly specialized gear-cutting and automatic transfer machinery in Europe and where crown wheels and pinions are machined and assembled in rear axle housings and leave the assembly lines at the rate of four a minute, has been decorated in a uniform colour scheme. A light green has been used to harmonize with the modern lighting and to encourage operators in good housekeeping.

Conveyor hooks carrying crown wheels and pinions through machining stages to the assembly lines are painted in three different colours, one for each series of vehicles from the Morris Minor 1000 and Austin A.35 to the Riley Two-Point-Six and Austin A.105. These colours give employees a valuable visual aid and help to reduce time waste.

The first stage of the plant's operation is the feeding of the rough material from stores for gear blank machining, after which the blanks are treated in a normalizing furnace. The pinion blanks are fed to a high-speed copy lathe, fitted with automatic loading equipment, which finish-turns bevel pinions at the rate

of over 50 an hour. The finished-turned gear blanks are carried on an overhead conveyor through an automatic washer to the inspection benches. After examination, another conveyor transfers them to a battery of Gleason gear-cutting machines which are so arranged that one man can operate five. The first process completed, the crown wheels and pinions undergo various exacting examinations. They are still "soft" and need further treatment.

The heat treatment section, through which the crown wheels and pinions next pass, houses a battery of gas carburizing furnaces which prepare the gears for the surface hardening process. The crown wheels are carried to rotary furnaces for reheating then to quenching presses while the hypoid pinions are carried by overhead conveyor to their special combined reheating and quenching apparatus.

Now in the hardened state, the crown wheels and pinions are lapped by running pinions and crown wheels together with an abrasive compound, and each set is then tested and subsequently kept together.

Trays then carry all the components to make up complete differential units to the assembly conveyor where men carry out assembly. After assembly each unit is carried by overhead conveyor to a soundproof enclosure where they are run up to 3,000 rpm on testing machines. At this speed, trained operators can hear any irregularity.

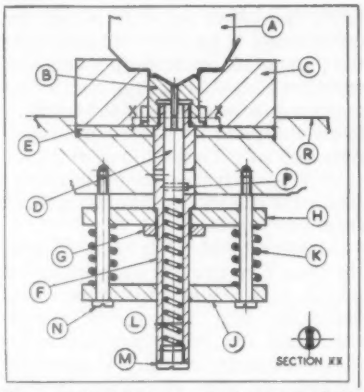
Special Pad and Ejector

The pressure pad and ejector shown in the sketch was designed for use on long bending brake tools and several were spaced at intervals along the lower tool inside the bolster to provide extra pressure to hold a component and to lift it clear and so make loading and unloading easy. The lower tool was raised on a fabricated bolster to give the necessary height to allow the spring sleeve to clear the machine bed.

The device is not restricted to this class of press because when additional pressure is necessary to prevent skidding and a positive ejection is essential when working at comparatively high speed, the equipment is well worth while and the extra cost is frequently saved by the positive action eliminating the tendency to broken punches should the material stick in the lower tool.

The sketch shows the punch A at the bottom of the stroke and the channel-shaped material pressed to shape and ready for ejection. In the initial stages the sliding die B is level with the top surface of the die C and the inner pad D is also level with both; thus the strip material is gripped securely at the centre as the punch descends.

To provide extra bearing surface the pad D is elongated (section XX) as the first short distance travelled by the punch causes the metal to assume V-shape and a fairly high pressure is advisable. Further movement then exerts pressure on the sliding die B and this commences to sink into the outer die C, and a further gripping force is applied to the material due



Pressure pad and ejector to exert extra pressure during pressing operation and on the ejection of the part will also break the seal caused when greasy material is used

to the action of springs K, and at the same time the upward pressure of spring L is present. Thus the component is adequately gripped during the complete descent of the punch.

The inner spring L is housed in a sleeve F which is in turn screwed tightly into the sliding die, and to restrict the movement of the pad D and so ensure that when in the released position it finishes flush with the die, a pin is inserted at P which operates in a slot milled in the sleeve. To this is attached a plate, and it is by the action of springs K on this plate that the sliding die B derives the pressure to resist the downward movement of the punch. The other plate J is for compression; the springs bear against it and it is anchored to the bolster by screws N.

Ejection is simple. The lower tool rises and both die B and pad D lift the component from the die, and as the sliding die ceases to rise the pad pushes the workpiece from the V when an air blast can remove it.

The advantages of diamond shaped storage racking are illustrated in this picture, taken at the Edmonton factory of British Oxygen Gases Limited (Equipment Division)

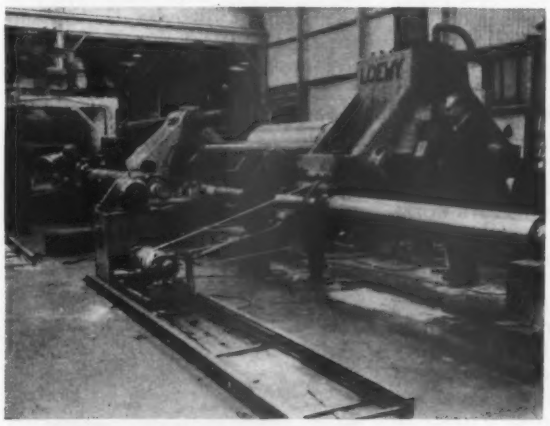
Diamond Stacking Saves Space

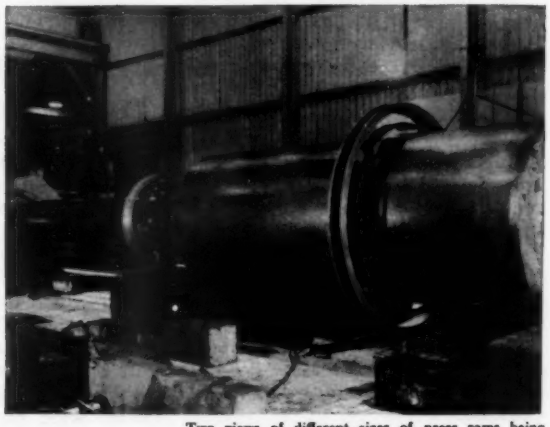
A problem which involved the storage of welding rods at the Edmonton factory of British Oxygen Gases Limited (Equipment Division) has been solved by the use of echelon stacking. Using Dexion slotted angle, racks have been arranged in diamond formation which affords faster handling of materials and a reduction in the maintenance costs of fork lift trucks.

The decision made in favour of diamond racking was influenced by the design of the building. The ceiling, which was 12 ft 6 in. high, was supported by a number of large pillars at intervals of 15 ft 3 in. It was found necessary to store 400 tons of material in 1-ton unit loads, 12 in. high on 3 ft square pallets.

All attempts to design straight racking led to a low standard of space utilization, either due to the fact that the bay widths were dependent upon the pitch of the pillars, or because the pillars obstructed gangways. The logical bay width for a 3 ft pallet was approximately 3 ft 7 in. and in this case the diagonal distance across each bay proved to be nearly one-third of the distance between pillars. By merely rounding up the dimensions of the bays to coincide exactly with the pitch of the pillars, it was possible to provide a neat workable layout and at the same time conceal

the pillars within the structure of the rack without sacrificing storage area. The racks have a guaranteed safe load of ten tons per square yard but each is used to support only five tons of equipment.





Two views of different sizes of press rams being trued on site by the Master-Hone process

Truing Large Press Rams on site

An interesting repair project, involving the regrinding of a series of rams, was recently carried out on site by Nicol & Andrew Limited of Hillington, Glasgow, using their patent "Master Hone" process. The work took place at the Redditch factory of Reynolds T.I. Aluminium Limited, and arose from the reconditioning of a 2500/500 ton Loewy extrusion press for aluminium sections and tubes.

The main ram of this press was 45 in. dia × 9 ft 4in., stepped down to 19½ in. dia × 9 ft 4 in., overall length 18 ft 8 in. and weighing approximately 30 tons. The 45 in. dia portion of the ram required removal of 0·024 in. to ensure a round and parallel surface, and the 19½ in. dia portion required removal of 0·075 in. in order to rectify wear that had taken place over a number of years. It was essential that, after the regrinding, the 45 in. dia and the 19½ in. dia should be concentric to one another.

A similar treatment was carried out on the twin main return rams, which have two working diameters of approximately 6 in. and 18 in. and an overall length of 23 ft. Again it was essential that the two diameters should be concentric and that the twin rams should have identical diameters.

The piecer ram of 20 in. dia × 12 ft long was also reconditioned with Master Hone equipment, and with this workpiece it was possible to give a remarkable demonstration of the accuracy of the repair. A bronze neck ring for use on this ram had been obtained with the hole machined one thousandth of an inch up on the diameter to which the ram was finished. The neck ring was placed on the ram and three fitters were able to push it along the ram from end to end, over a distance of 12 ft without the slightest sign of increased or decreased pressure during the experiment. The experiment proved conclusively the accuracy of the diameter, parallelism and the surface finish of the ram.

The press has now been in operation for some weeks since the complete overhaul. Reynolds T.I. Aluminium have requested the manufacture of what will be the largest diameter external Master-Hone grinding and honing head yet made to carry out a similar operation on a 57½ in. dia × 12 ft long ram of a 5000 ton Loewy extrusion press.

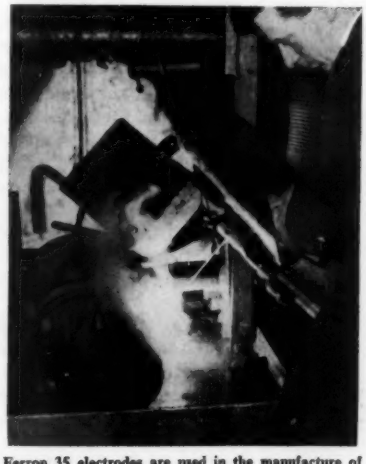
Welding and Hardfacing of Rock Bits

At their plant in Manchester, Security Rock Bits Company Limited manufacture three-cone rock bits which are capable of drilling holes with diameters of between 5⅞ and 12¼ in. In each size range there are various designs of cutter profiles and teeth to enable rock formations of different hardnesses to be drilled. The cutters and arms are made from nickel-alloy steel forgings.

A rock bit, or rock boring tool, consists of rotatable cutters mounted on a body made of three (or four) welded segments. Each cutter is free to rotate on its ball and roller bearings. At the other end of the bit is a threaded male connection so that the bit can be attached to a length of drill pipe which acts as a "driving shaft".

The pipe is hung from the top of a derrick and rotated by means of a rotary table. The weight of the rotating pipe is used to force the bit into the ground; the cutter teeth then bite into the formation, causing the cutters to rotate on their individual bearings. In this way they tear into the ground as the bit penetrates deeper.

To clear away the cuttings from the bottom of the hole, a slurry is pumped down the inside of the drill pipe and jetted on to the rock bit cutters via the bit body. It is then returned to the surface up the outside of the pipe, carrying the loose formations with it. At the surface, the slurry passes over a shaker screen,



Ferron 35 electrodes are used in the manufacture of rock boring tools by Security Rock Bits Company Limited

where the cuttings are separated into filter tanks and the slurry re-circulated.

To help withstand the severe abrasion during drilling the teeth of each cone are faced with tungsten carbide, deposited by means of oxy-acetylene welding torches. Considerable skill is called for in this operation to achieve good bonding and a uniform deposit. After hardfacing, the cones are carburized, hardened and tempered, and the ball and roller tracks in the bores are then finished-ground on internal grinding machines.

Part of the arm segments of the rock bit also has to be coated with wear-resistant material, to a depth of approximately $\frac{1}{16}$ in. Here again, considerable skill is needed to produce a deposit of the correct composition.

After welding, the surface is circular ground, and must be free from any gas holes or cracks. Specimens are taken periodically, given compression tests to test the efficiency of adhesion, and cross-sectioned for micro-examination of the structure in the laboratory. The arm segments are then carburized, hardened and tempered before assembly into the complete bit.

After the cones and bearings are assembled on their respective arms, the three segments are clamped together and located by means of dowel pins. Down the outside of each of the three seams is a deep weld groove approximately $\frac{1}{2}$ in. wide and $\frac{3}{4}$ in. deep, and the seams also extend across the top of the assembly under the cutters.

After tack welding, the clamps are removed and the bit head is placed in a fixture which allows both vertical adjustment and rotary movement.

For this heavy welding operation the inert gas process performs a sound job on the outside seams. The sections of seam under the cones are not accessible with the inert gas gun, and for these joints Quasi-Arc Ferron 35 electrodes are used. All the welds have to be free of any porosity, since the welded assembly has to be set up in a lathe and the thread connection machined. After turning and threading each weld is checked on a crack-detecting machine.

When in use on modern drilling rigs, the bits have to withstand loads up to 60,000 lb at speeds of 150 to 200 rpm, and in conditions such as these, good quality welding is essential.

Wells have been drilled to depths of 20,000 ft, and should a rock bit come apart or prematurely fail whilst in use, the work entailed in pulling the pipe out of the hole (in 90-ft lengths), recovering any loose pieces of steel to facilitate further drilling, and going back in, is considerable.

The life of the bit varies greatly according to the formation being drilled, the weight on the bit, and the speed of rotation. Once in the hole, the bit is run until worn out, and when "pulled" is scrap. Under average conditions the life of each rock bit is approximately 25 hr.

Terylene Conveyor Belting Development

As part of the general industrial development of high-tenacity Terylene filament yarns a trial Terylene conveyor belt was installed at a works of I.C.I. Lime Division, to replace a cotton belt which failed completely in just over one year. The conditions under which this conveyor operates are particularly severe and it is used for the conveyance of limestone rock direct from jaw crushers under wet conditions. The Terylene belt was 30 in. wide made from 5 plies of 32 oz duck with $\frac{3}{16}$ in. top and $\frac{1}{16}$ in. bottom rubber covers and was similar to the cotton belt previously used except that the latter had a $\frac{5}{16}$ in. thick top rubber cover. After running for 2½ years a point was reached when the top rubber cover could no longer be repaired satisfactorily or economically. It was apparent that further running would have resulted in damage to the carcass of the belt, and it was estimated that if it were run to destruction as would have been the case normally, a further six months' service at least would have been obtained.

Since the plies were virtually undamaged, it was decided in consultation with the manufacturers, The Leyland & Birmingham Rubber Company Limited, that there was a good chance of obtaining a further extended period of service from the belt if it were re-covered. The belt was withdrawn from service and has now been re-covered, apparently satisfactorily, although since the belt which replaced it, also of Terylene, is still running, there has as yet been no opportunity of testing the re-covered belt.

The successful performance of the Terylene belt has been in part due to the very high order of adhesion (of the order of 35 lb/in.), obtained between the top rubber cover and the carcass. Less maintenance was required and such repair work that was carried out was perfectly adequate. Satisfactory repairs to the cotton belt were generally not easy because it was difficult to dry out the canvas properly before patching on site due to the high moisture uptake of the cotton. This is a well-known problem with conveyor belts which are running wet, and care must certainly be taken to dry them thoroughly before being patched.

This Terylene reinforced belt resulted in a saving of 44% in the cost per ton of limestone carried, had a life of 2½ years, compared with one year for the conventional cotton reinforced belting, and the cost of maintenance was much reduced

The cost of the Terylene belt, its installation and maintenance was £488, whereas the cost of the three cotton belts that would have been required over the same period would have been £960.

Casting Design for Economical Production

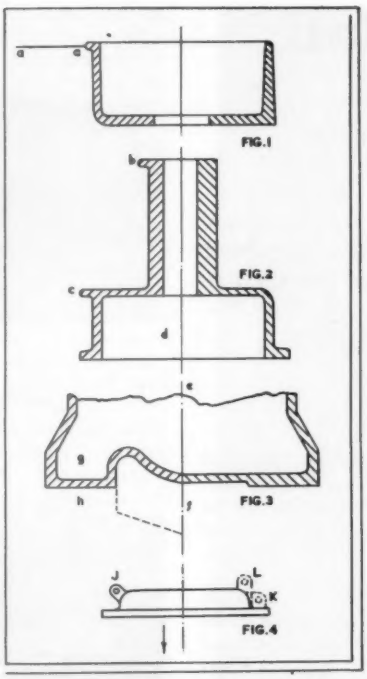
For cheap and expeditious production, castings should be of as simple a design as possible. It is far quicker to produce castings by machine moulding than by hand, thus the design should be such as to allow of the former method of moulding.

Moulding direct from a pattern is also superior to employing a block pattern with cores. Fig. 1 illustrates a cast iron guard, the left-hand half shows the original design, and the right-hand the casting as made. In the former case it was necessary to joint along line aa to form the bead portion and also to remove the interior by means of a core. The modified design, although not so artistic in appearance, was equally

as efficient in use and could be moulded direct. Four patterns with ample taper, and mounted on a small moulding machine, enabled the castings to be produced far cheaper than the original design.

The beads b and c on the casting shown in Fig. 2 made it necessary to mould in two halves jointed through the centre and to core the whole of the interior. This method needed a core to remove the large portion d whereas if the beads were removed as shown on the right-hand half, the pattern could be moulded direct and far more cheaply. The only objection to this design is that it is not so ornate as the original. This, however, should not be the ruling factor as the utility of the casting is not at all impaired by removing the beads.

The left-hand half of Fig. 3 shows the lower part of a gear box as designed while the right-hand half illustrates the modified design which was an improvement from the point of view of production. Because of other details on the casting, not shown in the sketch, it was necessary for the pattern to be jointed along the centre line e f. The interior had to be cored. The portion g created a little difficulty in assembly, for if the foot portion h was made loose on the pattern, to be withdrawn into the mould cavity after the main pattern had been extracted, the pod of sand remaining would prevent the main core being dropped into position. Similarly, if the back portion was cored out, the core for this could not be dropped into position but an enlarged print would be necessary and the core dropped down and then slid into position, an operation costly in time and also conducive to waster risks. By altering the bottom to the form shown on the right-hand half the operation of core assembly was greatly facilitated.



Figs. 1 to 4 show at left and right of centre line the old design requiring elaborate coring and new design permitting moulding directly from the pattern

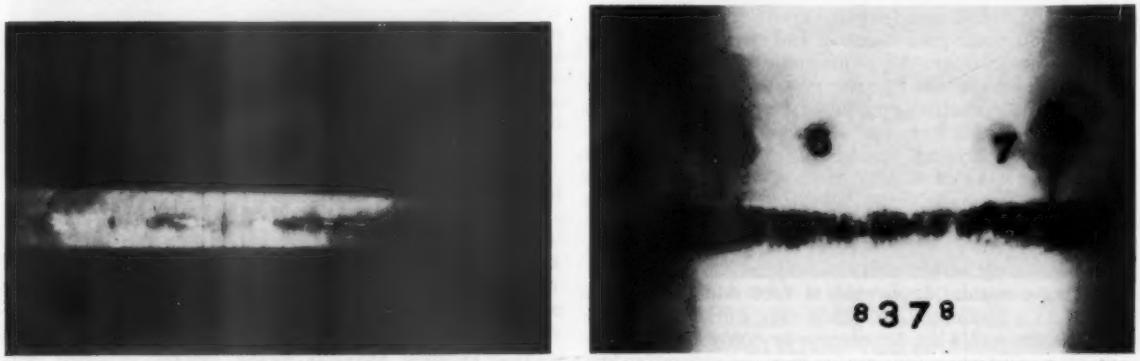
Occasionally it is necessary to cast ears on a casting to enable it to be lifted. The position of these can make a great difference in the cost of the castings and often can be changed from their original position without any detraction to the utility of the casting, yet improving the mouldability of the pattern considerably. Fig. 4 illustrates such a case. The pattern was to be withdrawn in the direction of the arrow and the ears J had consequently to be left loose and drawn into the mould after the main pattern had been withdrawn, thus making it awkward to insert the core needed for the lifting holes. By modifying the design so that the ears could be moulded direct as K or alternatively as L the production of the job would be accelerated considerably.—**T. R. Harris.**

Reducing "Piping" in Pipe Joints

"Piping" (also known as "wormholes") is a common fault in pipe butt welding, especially in welding by the upwards method.

Piping frequently occurs in the root run of a pipe joint, particularly when a heavy weld is deposited and when the penetration bead is rather large. Thus it is most likely to occur in areas of excess penetration, i.e., between the 9 o'clock and 12 o'clock positions in a pipe joint.

Recent research in the laboratories of Quasi-Arc Limited and reports from some of the firm's customers have shown that piping can be considerably reduced by the use of a wider root gap. This may seem rather contradictory, since a wider gap would seem to indicate a larger root run, but, in fact, if the gap is sufficiently wide it is possible to reduce the amount of heat right in the centre of the pool where piping usually occurs. This is achieved by using a weaving technique with a slight pause at the edges and a rapid flick across the centre of the pool which keeps the weld bead as thin as possible. The work carried out has shown that the gap should certainly not be less than $\frac{1}{8}$ in. and should preferably be of the order of $\frac{5}{32}$ in. with a $\frac{1}{16}$ in. root face. This applies to all thicknesses and diameters of pipe, but does not apply where the pipe is welded by the "stove-pipe" or vertical downwards method. It is, of course, advisable to use as small an electrode as possible, preferably a 12 swg but certainly not more than a 10 swg for all root runs in pipes welded by the upwards method.

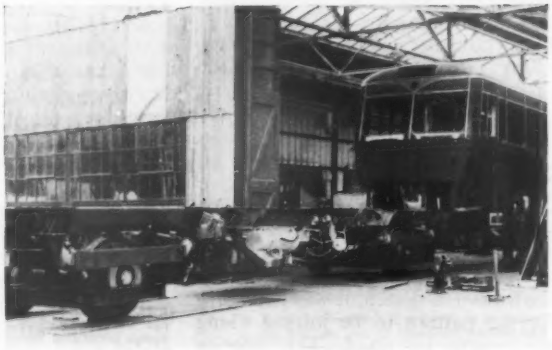


Left: Radiograph of a pipe joint welded with a $\frac{1}{16}$ in. root gap. The pressure of "piping" is clearly revealed. Right: A similar joint, welded using a larger $\frac{1}{8}$ in. root gap showing marked improvement in the weld quality

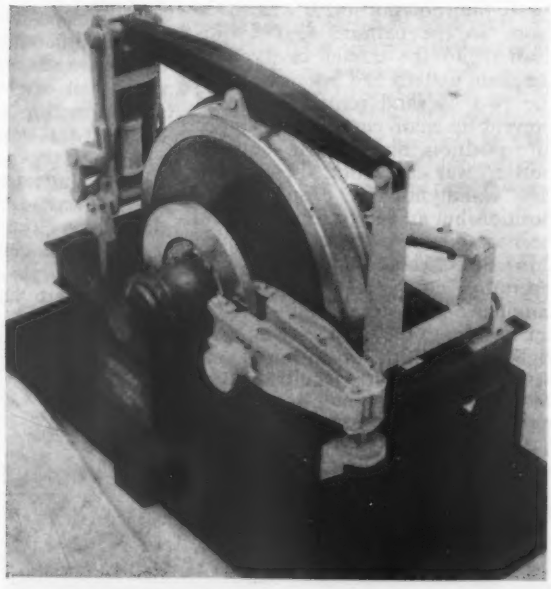
New B.T.C. Rail Buses

The new B.T.C. rail buses are characterized by an unusually low floor, resilient wheels new to Britain, particularly simple driving controls and the new Dunlop Monitor braking system.

The completed railbus



Chassis prepared for mounting of body



Model showing layout of the Dunlop Monitor braking system

THE light weight diesel rail buses specially designed for rural services on British Railways have been built jointly by two road undertakings in the ownership of the British Transport Commission—Bristol Commercial Vehicles Limited, and Eastern Coach Works Limited, Lowestoft, both of the Tilling Group.

The general construction is based on an integral design having an all-steel underframing, whilst the body is constructed entirely of aluminium alloy extrusions and panelling, and is completely integrated with the underframe, thus providing maximum stiffness. Sound and thermal insulation is provided by filling the space between the interior and exterior panels throughout with a lightweight plastic insulating material. Acoustic panels of 2 in. thickness are fitted below the floor, and the floor is covered throughout with sound deadening material below the wearing surface. All the windows are safety glass glazed by the Eastern Coach Works Fastflex system. Six hopper-type ventilating windows are fitted to each side of the body.

The engine is a Gardner type 6 HLW 6 cyl. diesel of 8·4 litres capacity and developing 112 bhp at 1,700 rpm. The maximum torque is 358 lb–ft at 1,300 rpm. The engine is flexibly mounted amidships below the body floor.

The clutch is an 18 in. fluid flywheel unit by Self Changing Gears Limited incorporating a centrifugal lock-up clutch to provide a positive drive at speeds above 700 rpm. Drive from clutch to gearbox is through a short cardan shaft embodying a free wheel unit. The gearbox, also by Self Changing Gears Limited is a 5 speed (overdrive) epicyclic type R.11.B. giving ratios of 4·07, 2·42, 1·6, 1·0 and (overdrive) 0·77. It is arranged for fully automatic gear selection and engagement by the Self Changing Gears VS Automatic Control System. Gear engagement is by air pressure controlled by Westinghouse electro-pneumatic valves operating in response to signals from the VS control.

The control system has been evolved by Bristol Commercial Vehicles in collaboration with Westinghouse and Self Changing Gears. Westinghouse pneumatic equipment is used for throttle and brake controls and for gearbox operation. Transmission control is fully automatic from standstill to maximum speed.

Driving controls (duplicated at each end) have been reduced to a minimum and made very simple in action. A single removable master control key only is used. The controls consist of an accelerator lever incorporating the dead man handle, an air brake lever, a horn lever, a handbrake lever, and a direction lever for forward and reverse motion selection and engine stopping and starting (this is the master removable key). The whole driving technique can be mastered within about 10 min.

The Dunlop Monitor brake system is fitted and arranged for air/hydraulic operation to discs at each

wheel. The handbrake is of bus type, mechanical and operating on all wheels and arranged for independent application or release from either end of the vehicle.

A beam carrying monitor shoe is pivoted on two vertical links, these in turn pivot about their mounting brackets. An air operating cylinder is positioned in one vertical link which brings the monitor shoe into contact with the wheel rim, thus causing the vertical links and beam to swing in the direction of wheel rotation. An extension arm from the second vertical link energizes a hydraulic double acting master cylinder, this supplying fluid under pressure to the caliper operating cylinder and forcing the friction pads into contact with the disc.

Air supply to the brake operating cylinder is controlled manually by a lever on the driver's desk. Each brake is independent although all brakes are applied together. Hydraulic fluid is supplied from two tanks, each tank having separate compartments for each brake.

The oil level in each tank is shown by a sight tube. Vents for the air cylinder and caliper cylinder are piped through transparent plastic hoses to points above possible flood water level. Vent pipe extremities are fitted with filters. The brakes can be mechanically operated by means of a handbrake lever in each driver's cab.

Pad clearances with brakes off are automatically maintained at a constant amount, no adjustment being necessary. Pads are changed when fully worn by removal of a split pin and nut, allowing the carrier plate to be withdrawn, the caliper arms are then opened by a tool provided and the new pads secured in position.

The single driving axle case is a Kirkstall pot type steel forging carrying the double reduction final drive unit. The driving axle is similar to a bus or heavy lorry axle, except that it has no differential. There are two spiral bevels for forward and reverse, which are engaged by dogs operating from air cylinders. An interlocking device is fitted which prevents any movement of the vehicle until the dogs are correctly engaged. A manually operated neutral position is provided to allow the vehicle to be towed should it be necessary. The wheels on the trailing axle can revolve independently.

The wheels are of the Svenska Aktibolaget Bromsregulator resilient type, rims being flexibly mounted relative to the wheel centres by a system of rubber "bobbins", thus reducing wheel shock and noise when traversing rail joints, etc. The wheels are detachable from the hubs, thus making for easy removal.

Suspension is by Metalastik rubber units in two stages. Each axle is attached to a sub-frame through two pairs of chevron type rubber sandwiches, while the main structure is supported from the sub-frames by eight Metalastik rubber spring units, four at each sub-frame. In side elevation the axes of the spring units make an angle of 15° with the horizontal and load is taken by the rubber in compression and shear. Damping is by separate vertical and horizontal telescopic hydraulic units and brake torque reaction links are fitted at both axles.

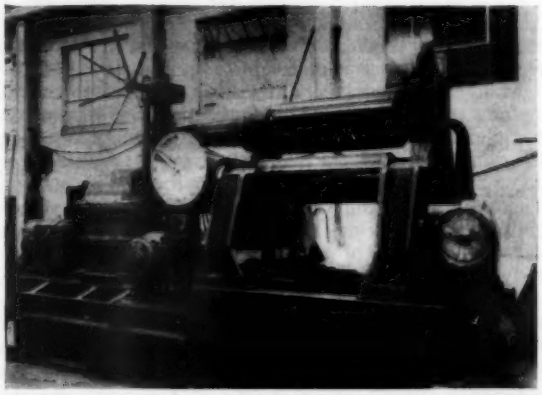
The electrical equipment comprises a C.A.V. a.c. generator, type 824/2, rectifier and control board (24 volt d.c.). An alternator is driven by multiple V-belts from the front end of the gearbox at 2·8 times engine speed. The battery is an Exide, type 3 BMF 17/2, of 296 amp-hr capacity.

Instruments provided are a thermometer for engine cooling water, an air pressure gauge and speedometer and mileage recorder. The windscreen wipers are Trico type F.P.K. heavy duty with 70° wiping arc.

One of the driving compartments of railbus built by Tilling Group Companies

A Coventry flattened tube type radiator is suspended below the vehicle floor between the engine and the trailing axle, The header tank and filler cap are at the side of the vehicle and are accessible through an aperture in the skirt panel. Coolant capacity of the system is 10 gal approx. A single 38 gal fuel tank is mounted below the floor level at one end of the vehicle and supplies both the engine and the Smiths combustion heater.

To dispense with measurement of the oil level by a dipstick, an engine oil dispenser has been fitted which automatically tops up the oil sump from a reservoir tank. A sight glass gauge is visible from the outside of the vehicle and the reservoir tank only occasionally has to be filled up.



PYRAMID-TYPE ROLLS FOR 2½ in. PLATE.—This heavy duty bending rolls machine has capacity for mild steel plate 3 ft 3 in. × 2½ in. thick using an 18 in. dia top roll and two 15 in. dia rolls. The main 40 hp drive is through all-enclosed gearing, the top roll adjustment is worm gear driven by a 20 hp motor and the end bearing housing is swung down by a 3 hp motor. A large dial indicates the position of the top roll ends which are fully protected against overrun. The makers are Bronx Engineering Company Limited, Lye, Worcs.

Welding and Brazing in Atomic Reactor Construction

Components built up by brazing have been found to be very satisfactory under severe operating conditions

SCIENTISTS at the Oak Ridge National Laboratory, operated for the United States Atomic Energy Commission by Union Carbide Corporation, have added to welding technique by providing carefully controlled procedures of fabrication and welding.

One of the most important requirements for successful operation of nuclear reactors is absolute leak tightness. All components must be designed and fabricated with a view towards the longest possible service life without the need for maintenance.

In many reactor applications, particularly when elevated temperatures are involved, this service life can only be achieved by the exclusive use of welded joints. The ultimate in weld quality is assured by careful selection of optimum welding procedures, intensive training of welding operators and application of as many reliable inspection methods at every stage of fabrication of a reactor component as is feasible.

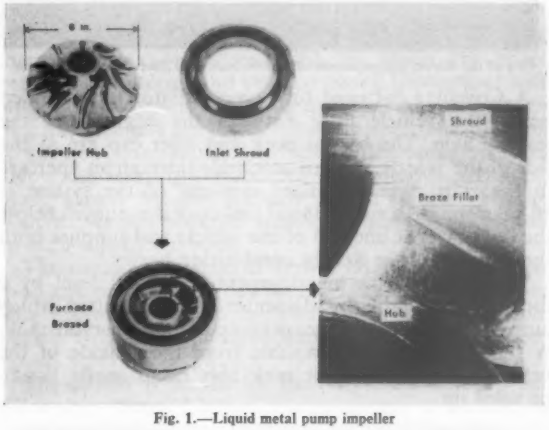


Fig. 1.—Liquid metal pump impeller

Many components characteristic of nuclear reactor systems are unusual and unconventional in dimension, complexity, and material selection. In many instances the difficulties imposed by design are most readily overcome by the utilization of brazing as the joining method. There are many joints in the fabrication of fuel pumps, control rods, shields, thermocouples, heat exchangers, valves and pumps of nuclear reactors which are particularly amenable to brazing.

Brazing meets the strict physical and metallurgical requirements imposed by reactor application and nuclear properties including corrosion resistance, mechanical strength and the metallurgical bond for heat transfer.

Typical of these properties is the pump impeller shown in Fig. 1. This impeller was originally designed for casting but was finally fabricated from a wrought corrosion resistant alloy by inert gas shielded tungsten arc welding and furnace brazing. This procedure was found necessary since castings of the alloy exhibited inadequate corrosion resistance to liquid metals in some critical applications. The vanes shown were welded to a machined hub followed by re-machining to permit close fit of the inlet shroud. The shroud was then furnace brazed to the hub. Impellers of this type have operated successfully for extended periods.

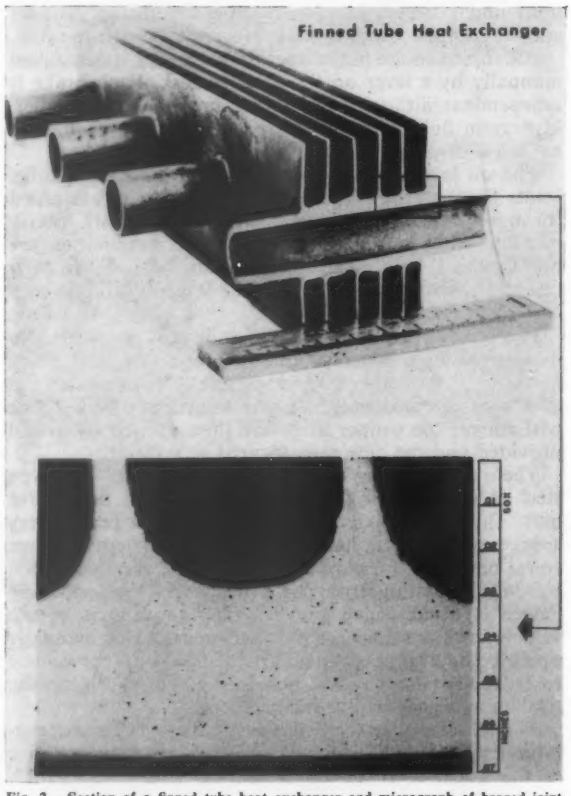


Fig. 2.—Section of a finned tube heat exchanger and micrograph of brazed joint between tube and fin. Ni-P brazing alloy. Etched with glycera-regia

Heat exchangers, used as heat dumps in experimental programmes utilizing liquid metals, have also been successfully brazed. The finned tube (shown in Fig. 2) is a very efficient means of transferring heat to air. Extremely high heat transfer efficiencies can be obtained by metallurgically bonding the fin to the tube by high-temperature brazing. The punched fin lips serve as spacers for the individual fins and provide a suitable contact surface for brazing. Good filleting and braze adherence can be obtained with this procedure.

Brazing of joints may be made in a vacuum, hydrogen gas or inert gas atmospheres, with dewpoints carefully controlled.

Pressure Vessels in Nuclear Plants

Some points of construction and use from the safety angle

By HENRY ALLEN

NUCLEAR plants have raised many new problems for the safety engineer and inevitably the code of safe working practice is not yet completed. Such finality as has been achieved in other production processes is not yet possible while so much experiment and empirical determination of hazards and control is going forward.

With some aspects of safe working, that, for instance, which is largely concerned with what one might call the objective position—equipment and installations rather than materials and processing—a great deal of the data already established and the experience already accumulated in other fields can be applied. Pressure vessels in nuclear power work are an example where observations and experience from earlier applications has done much to reveal potential hazards and to lead to suitable control measures. Most important, however, is the clear evidence that in the present experimental design stage with pressure vessels for nuclear power it is imperative to include "built in" safety, which involves right selection of materials to withstand the stresses and the abnormal service conditions that so markedly differentiate nuclear power pressure vessels from others. It is much more important with nuclear power vessels that an exceptionally high standard of workmanship at the fabrication stage be ensured so that construction is as vital in the safety code as design.

In this matter of construction of the vessels a major point is the adequacy of the welds. Evidence so far assembled suggests that one of the chief hazards may be cracking near the welded joints, though this may not necessarily involve leakage of the primary system contents into the secondary system. Investigation has suggested that such cracks may be caused by stress corrosion, thermal stress, fatigue, or locked-in stresses from welding. It is imperative in selecting the material for the pressure vessels to ensure that the mechanical properties are right as regards ductility, tensile strength, creep-rupture, impact strength and endurance limit. Brittle fractures near welded joints ought not to occur if the material used in the construction of the vessel is suitable. It is, of course, also necessary to make some tests of the effect of irradiation on the mechanical properties of materials, and this is a field where further research must be done since the designers need to have the data about the effect of neutron bombardment and gamma radiation on constructional materials and it is far from being fully documented yet.

Such research as has already been done has established that the impact strength of carbon steels used for pressure vessels is lowered by irradiation. Some alloys are made harder and more durable. Reduction of impact strength would increase the risk of brittle fracture. Research has gone further in establishing that where irradiation produces a tendency to brittleness, that tendency can be controlled, and even negatived by the annealing effects of high operating temperatures. In this whole field of materials selection and reliability we are still largely at the wait-and-see stage and, only reactors in service for some considerable time can supply the evidence necessary.

Reactors rely on pressure vessels to contain the coolant and other liquids or gases. Of the three kinds of pressure vessels now used in nuclear power plants, the secondary system vessels, normally located outside the containment vessel and very similar to vessels used in the traditional steam-electric power plant, are the least troublesome to the safety engineer. For one reason their location means that they can be readily inspected and secondly they are not usually radio-active. They include evaporators, water tanks, air tanks, heat exchangers and so on, all of whose characteristics and behaviour are well enough known. It is the primary coolant and reactor pressure vessels that have yet to be fully blanketed with a safety code. The contents of these vessels are subjected to high level irradiation, and the reactor vessels in particular are subject to high thermal stresses and corrosion. Operating temperatures range from around 300° to more than 1,000°F and operating pressures for vessels containing coolants range from atmospheric pressure up to more than 2,000 psi.

The third type of pressure vessel in the system is that which contains the primary system components. It operates usually under slightly higher than atmospheric pressure and is designed to withstand internal pressures from a rupture of the primary system.

One of the main hazards in the reactor system is explosion caused by a superheated coolant, released by a rupture into the steam system. With such an explosion it is likely that there would be little fragmentation as the failure would be of the ductile kind. A noteworthy exception would be if a cover plate became detached from the pressure vessel—it might carry with great velocity over a considerable distance.

A detailed system of testing for leakage is required if the escape of hazardous fission products from reactor pressure vessels is to be controlled. The test techniques at present in use are effective enough, including as they do pneumatic and hydrostatic tests, mass spectrometry in its several variations and radiographic examination of all welds.

Almost as important is the need to formulate starting-up, shutting-down and operational methods. The maintenance and inspection programmes offer quite a bit of difficulty. The reactor and primary coolant vessels, the contents of which are subject to high level irradiation, can hardly, if ever, be available for internal inspection. It is essential that eventually a means of remote examination be set up but at present the chief reliance must be on such indicators of deterioration as leak detectors. Protective systems for reactors are very detailed, and

being made to "fail safe", cover such hazards as circulation failure, excessive temperature and so on.

Pressurized water reactors and boiling water types being more common at present than, for instance, aqueous homogeneous and sodium/graphite, it is important for safe working to maintain the water non-corrosive. Stainless steel as the material for the pressure vessel does keep the corrosion hazard low, but oxygen and hydrogen are released by water decomposition and the result is that the water is made more corrosive, so that there is the risk of a build up of corrosive products which will become radioactive.

Thermal stress is another field where evidence is beginning to elucidate some safe working problems. It is already established that if the metal plate is too thick the heat generated cannot be reduced quickly enough so that high thermal stress follows. Thermal stresses heighten in ratio with the wall thicknesses of the shell plates and heads of the reactor vessels. If the reactor is subject to frequent load change, fatigue may follow and consequently thermal stress. It has to be appreciated that nuclear power pressure vessels differ from those in the conventional system in that the rate of heat generation can change extremely rapidly in the reactor, though in the conventional system the rate of rise is controlled by the rate at which fuel is supplied and consumed.

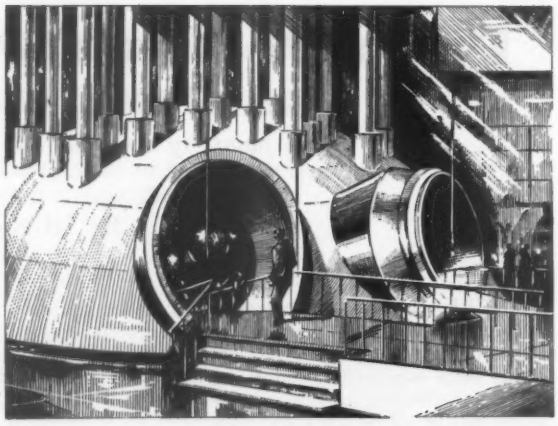
Safe working with reactor pressure vessels is indeed a complex matter but already the way for competent codes of accident-free practice is being cleared. Safety begins with the design and fabrication stage—it ends, perhaps with reliance on fully educated supervisory control. As nuclear power pressure vessels increase in complexity and application the safety codes will amplify; at present it is the responsibility of everyone working in the field to add the findings of experience.

To Make Beryllium

THE beryllium plant which Imperial Chemical Industries Limited, Metals Division, is to establish will be the first in Europe for the production of the wrought metal. Semi-fabricated forms will be made such as rod, tube and plate, and finished machined parts. The task will be the execution of a production scale contract placed with I.C.I. by the United Kingdom Atomic Energy Authority (Industrial Group) as part of a nuclear development project. Subsequent spare capacity may find additional outlets for this unusual metal, as for example in the aircraft industry.

Interest in beryllium as a nuclear engineering material has been intensified by the need for a metal which will perform satisfactorily in the higher operating temperatures envisaged in gas-cooled reactors. For the present programme of British reactors, operating at temperatures up to about 470°C., special magnesium alloy materials are used for sheathing the nuclear fuel. For the higher temperatures needed to obtain increased thermal efficiency, materials with greater strength at these temperatures must be used and the most promising of these is beryllium.

This metal, which has a melting point of 1,280°C., is light in weight, has good mechanical properties and good corrosion resistance to carbon dioxide at elevated temperatures. In addition, beryllium has by far the lowest neutron absorption cross-section of any of the possible constructional metals. For this reason, the Industrial Group, U.K.A.E.A., intends to use beryllium fuel cans in its Advanced Gas-cooled Reactor, in which fuel element surface temperatures as high as 600°C. are planned.



MODEL OF REACTOR.—This sketch is of a full-sized model of a section of a nuclear reactor which was a feature of the stand of the General Electric Company Limited and Simon-Carves Limited at the "Atoms for Peace Exhibition", Geneva. Visitors entering through one of the gas-outlet ducts saw all the principal components —graphite core and reflector, boron sandwich shield, double-shell pressure vessel, fuel elements, control rods, and gas-sampling tubes for burst-cartridge detection equipment. The model is of a gas-cooled graphite-moderated reactor, of similar design to the two which will power the 320 MW nuclear power station now under construction by G.E.C. and Simon-Carves at Hunterston, near Glasgow, for the South of Scotland Electricity Board

The handling and fabrication of beryllium involve specialized techniques to overcome difficulties arising from its particular metallurgical characteristics and from the toxic properties of the metal in certain compounds and forms. Thanks to considerable research into the safe handling of beryllium products which has been carried out by the U.K.A.E.A., stringent standards of operation have been evolved and codified, and the I.C.I. plant will incorporate all the special features which have been found necessary for this purpose.

Some unusual features are involved in the manufacture of wrought forms of beryllium. The metal, which is received as flake or as small beads, is melted under vacuum in induction furnaces to produce an ingot. This is really a refining process; the cast ingot, having a large grain size and very poor workability, cannot be rolled or extruded directly in the same way as are conventional metals. It has to be made into fine powder which is then heated and compacted (sintered) under vacuum to produce the various shapes required for further processing by conventional plant.

I.C.I. has been entrusted with this task following its already considerable contributions to the development of nuclear metallurgy. In the very early days, it solved problems connected with the extrusion of uranium and undertook the production of porous barriers for diffusion membranes in uranium isotope separation plant.

Much of the early work in devising suitable forms of sheathing (or "canning") for nuclear fuels was done by the Metals Division in conjunction with the Authority. I.C.I. aluminium cans are in use in many of the experimental reactors at Harwell and elsewhere, and the Division has manufactured and supplied prototype cans in magnesium and zirconium alloys to all the Consortia in this country and to official bodies abroad.

Marston Excelsior Limited (an I.C.I. subsidiary) was one of the first commercial undertakings to be associated with the U.K.A.E.A. in the assembly of research reactor

fuel elements containing enriched uranium, and has supplied ancillary coolers and brazed assemblies for the burst cartridge monitoring system at Calder Hall. Berkeley and Bradwell-on-Sea power stations will incorporate nearly 400 miles of I.C.I. "Integron" steel tubing in their heat exchangers.

The Metals Division has for many years undertaken special research and development on the "new" metals. Titanium and zirconium have already left this class and are in commercial production by I.C.I. Work is still proceeding on other metals, including vanadium, tantalum, niobium and beryllium, the last of which is now planned to be in production at the end of next year.

Other possible uses for beryllium

The potential uses of beryllium are not confined entirely to the field of nuclear engineering, and there is considerable long-term interest in the metal among aircraft and missile designers. Its very low density and high tensile strength make it a promising material for aircraft skinning. It is, in fact, reported that beryllium is being used in this way in North American Aviation's latest research aircraft X-15, designed to fly at speeds up to Mach 7.

From the viewpoint of the engineering designer, the metal's most attractive property is its high strength/weight ratio; it has a density little more than half that of aluminium and a stiffness four times as great.

Storage Batteries to Safeguard Berkeley Reactors

A current trend in nuclear power station design is to use storage batteries to safeguard plant against electricity supply failure. At the C.E.G.B. Berkeley station the d.c. bus-bars associated with the two reactors will normally be supplied from automatically regulated mercury arc rectifiers. Although the reactors will shut down automatically on a wide scale failure of the a.c. system, it will be necessary for the blowers to continue circulation of the gas coolant for a time to prevent the reactors overheating. In the event of failure, stand-by diesel sets, two to each reactor, will start up to provide the emergency power, but between supply failure and the diesel sets taking the load, the system will be fed automatically by two Chloride stationary batteries, each weighing over 120 tons.

On the loss of the power output of the mercury arc rectifier the corresponding battery will immediately pick up any load on the bus-bars. Both the diesel sets will then automatically start up, parallel their outputs on to the bus-bars and take over from the battery all or most of the d.c. load. One of the diesel sets could supply the majority of the load but two will be used as a precaution.

On the complete loss of the a.c. supply or a serious reduction in power from the normal blower drive, full emergency operation will come into effect immediately. The control rods of the reactors will fall in completely and d.c. pony motors, one on each blower shaft, will be connected to the d.c. bus-bars to drive the blowers at a much reduced speed to circulate sufficient carbon dioxide coolant to the shut-down reactors.

The normal drive of each blower will be through a Fluidrive variable speed coupling from an induction motor. The power required from the battery at the low blower speed, although relatively high, is only a fraction of the power normally required for each of the eight blowers associated with each reactor.

The batteries will be trickle charged from the bus-bars which will normally stand at a suitable voltage. The two reactor d.c. systems can be interconnected so that it will be possible to disconnect a battery and rectifier from the bus-bar system for quick rate or boost charging, the system load for both reactors being taken meanwhile from the other battery or from one of the diesel generators associated with the battery being quick charged.

Each comprising 118 FFW22 (45 plate) open topped Plante cells in lead-lined wood boxes with capacities of 4400 Ah at the 10-hour rate of discharge, these batteries are being built by Chloride Batteries Limited, of Clifton Junction, Manchester.

A 240-volt chloride battery will also be supplied for emergency lighting in the turbine house and reactor buildings, and current for flushing oil pumps, hydrogen seal pumps and circuit breaker closing solenoids. It will consist of 115 GLW10 (21 plate) open-topped Plante cells in lead-lined wood boxes, with a capacity of 1000 Ah at the 10-rate of discharge, and will weigh over 30 tons.

For switch-tripping, indicating duties and providing current for the contactor of the closing solenoids, a smaller 110-volt battery, comprising 55 DSNG4 sealed Plante cells in glass containers, with a capacity of 100 Ah at the 10-rate of discharge, together with the associated charging and control gear, will be supplied.

Bradwell Reactor Vessel Under Construction

The bottom two courses of the spherical pressure vessel for No. 1 reactor at the Bradwell nuclear power station, and the identical unit for No. 2 reactor, are the heaviest lifts to be undertaken by the Goliath crane. The unit is approximately 53 ft dia at its widest point and weighs approximately 215 tons.

The pressure vessels, which will be 66 ft 9 in. dia are the responsibility of Whessoe Limited, one of the eight members of the Nuclear Power Plant Company Limited which is building the 300-megawatt Bradwell power station. They are fabricated from steel plates varying in thickness from 3 to 4 in.

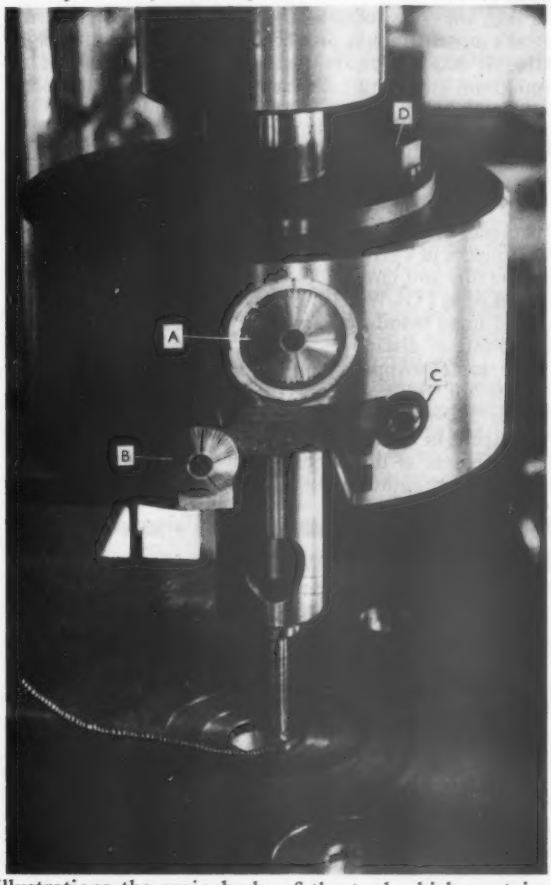
The size and thickness of these plates takes this operation out of the normal capacity of presses in this country. Whessoe Limited have therefore had a new press installed specially at their works at Darlington for this type of work. It has a capacity of 4,500 tons and is capable of handling plates 25 ft long by 10 ft wide.

After pressing, the plates are marked out in a special building, using a patented shadow projection technique to ensure the greatest possible accuracy in sizing. The plates are then cut to size in another special building, using a triple flame-cutting head mounted on the end of a long pendulum which is pivoted at a height about the plate equal to the radius of the sphere.

The Goliath crane, which was completed in March of this year, was designed specially to handle these ring-courses and other very heavy components such as the twelve 200-ton heat exchangers, one of which is already in position. The crane is 177 ft high, with a span of 178 ft and a clear lift of 140 ft, and is believed to be the largest of its kind so far in commission in this country. A picture of the crane appeared on page 471 of our October issue.

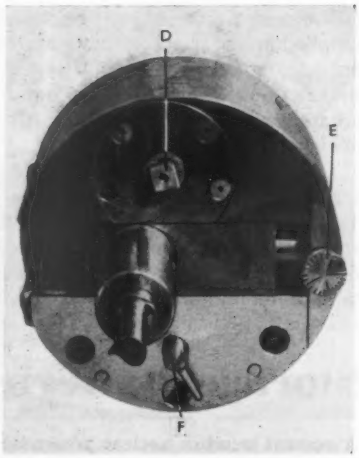
Self-contained Boring Head has Hydraulic Feed for Facing and Undercutting

Boring, facing or undercutting operations carried out with repeated accuracy on successive holes without the need for resetting is now a simple procedure with the Swintool, a universal boring and facing head developed by the Swindon Tool Company Limited, Trading Estate, Cheney Manor, Swindon, Wilts. As will be seen from the



illustrations the main body of the tool which contains the oil reservoir and actuating cylinder, carries a sliding head mounted in dovetailed slideways. A heavy compression spring acting on a piston provides the power for the integral hydraulic system controlling the 2½ in. travel of the slide. The feed rate which is steplessly variable is controlled by a knurled knob, E on the front face of the head and the extent of travel of the slide is governed by the micrometer stop A which is preset to the radius of the face or recess desired. A socket key is used to adjust the stop and the dial calibrated in 0·002 in. divisions provides 0·100 in. tool slide movement per revolution. Once the stop has been set any number of cuts may be repeated without further adjustment.

The tool slide is returned to the central position by turning the square headed return nut D with a spanner, this nut being extended through both faces of the head for convenience. The action of returning the slide compresses the spring and reloads the hydraulic system ready for the next cut.



Left, the Swintool universal boring and facing head with integral hydraulic feed mechanism in use on a vertical miller. A, micrometer stop for presetting facing and recess diameters; B, micrometer screw for setting boring diameter; C, screw to adjust the dovetail slide gib; D, tool slide return nut passes through both faces of the head

Right, view of tool slide and front face. D, return nut; E, hydraulic feed control valve; F, micrometer screw engagement lever

The head can also be used for normal boring operations but to ensure accurate setting the micrometer screw B must be used. Engagement of the screw with the tool slide is controlled by a small lever F on the face of the head and during all facing, recessing or undercutting operations the screw is disengaged by a full anti-clockwise turn of the lever. For boring operations the following procedure is adopted. With the control valve E completely closed and the slide set in the central position, the micrometer screw can be engaged by a clockwise movement of the lever F. The control valve is then released to reload the slide hydraulically and thus remove back-lash between the adjusting screw nut and the toolslide. Finally the micrometer stop A must be fully opened during normal boring operations by turning in an anti-clockwise direction.

The normal capacity of the Swintool is 5 in. dia but extension tool holders will enable 14 in. dia holes to be bored or faced.

Three-phase Variable Speed Drives up to 10 hp

An extension to its range of Varimag variable speed drives, which until now have been limited to outputs up to 2 hp operating on a single phase a.c. supply has been made by Lancashire Dynamo Nevelin Limited of Oxted, Surrey (a member of the Lancashire Dynamo Group) with the development of a three-phase unit available for outputs up to 10 hp. The drive comprises a speed controller and a variable speed motor. Basically, the controller is a magnetic amplifier giving a variable voltage output from a three-phase, bridge connected, semi-conductor rectifier, the level of voltage being determined by the setting of a hand operated potentiometer.

The magnetic amplifier is connected in such a way that the armature voltage of the variable speed motor is in constant balance with the reference obtained from the speed potentiometer. Any difference existing between these two levels of voltage, results in a signal into the magnetic amplifier in such a direction as to correct for the error. The speed controller is an entirely static piece of equipment, of robust design, and for the larger outputs makes use of silicon semi-conductor rectifiers.

The three-phase Varimag is available from 3 to 10 hp, and provides a speed range of 20:1. The variable speed motor may be switched direct-on at any speed and any load and will provide a speed regulation light load to full load of ± 2½%.

Magnetic Amplifiers

TO THE EDITOR OF MECHANICAL WORLD

Sir,—Referring to the article on Magnetic Amplifiers (July M.W.) I was surprised to find it stated that the alternative flux, Fig. 2, passes through the centre limb and to see the a.c. winding drawn to produce this effect. The magnetic amplifiers with which I have come into contact have used the three limb magnetic circuit for the specific purpose of keeping the alternating flux out of the d.c. control coil, the a.c. coils being connected so that their fluxes in the centre limb neutralize each other.

It is generally essential to keep the alternating flux out of the control coils because the latter frequently have many thousands of turns, and the p.d. produced across them by quite a small fluctuating flux may be high enough to cause, amongst other things, serious insulation problems. The introduction of the choke will not prevent p.d. build up; it may increase it. I speak with feeling since I have experienced "blowing up" a control coil inadvertently short-circuiting one a.c. coil of such a system, thus removing its neutralizing flux.

S. H. Rutherford, B.Sc.(Eng.).

North Wembley, Mdx.

The author of the article writes as follows:

The diagrams in Figs. 2 and 3 were intended to indicate how the various control windings can be used to saturate the core to obtain an amplifying effect, without detailing the various methods which may be used to reduce induced voltage in the control coils, which induced voltage only received brief mention in the article so that space could be allotted to applications. The purpose of the choke coil in the control circuit was not to reduce the induced voltage but to reduce fluctuations of current in this circuit which might affect the control.

Where the apparatus has a high turns ratio the induced voltage in the control circuit can be limited in various ways. As your correspondent states a three-limbed core may be used in which the main purpose of the centre limb is to carry the d.c. magnetism; a three-limbed core may be used with a.c. and d.c. windings on the outer limbs only with the centre limb mainly used for the d.c. flux; a double-core construction may be adopted with a.c. and d.c. windings on each core; a four-limbed core may be used with d.c. and a.c. windings on the two inner limbs, etc. There are advantages and disadvantages attached to each method.

Marquenching

TO THE EDITOR OF MECHANICAL WORLD

Sir,—I have read with some care the article on Marquenching in your issue for August 1958. Some of the statements appear to me to be misleading. For instance, "The bath temperature for martempering lies between 65 and 150°C." It is generally agreed by those who practise martempering that the quench bath temperature should be fairly close to that at which martensite begins to form. In quite low carbon steels this will be in the neighbourhood of 400°C and in high carbon steels such as EN31, 1% tool steel etc., about 200°C. Intermediate carbon steels will need intermediate temperatures. A reference to the "British Standard Atlas of Isothermal Transformation Diagrams" will confirm the above.

The main advantage of marquenching, in my opinion, is that the martensite which is formed at the temperature of the bath is tempered during the "holding time" and that the remainder of the martensite which forms as the temperature drops during air cooling is formed very slowly.

I think this practice with steels of sufficient hardenability is an excellent one as compared with normal oil quenching. It undoubtedly reduces internal stresses and distortion.

F. Padcock.
Kango Electric Hammers Limited.
Selsdon, Surrey.

Pipe Flow Scale Indicated by Flap Valve

An easy visual indication of flow fluctuation in pipe circuits is provided by the Rhodes No. 412 flap-type indicator in which a simple hinged flap valve is made to move behind graduated Perspex scales to provide a measure of flow.

The body of the indicator is supplied with screwed ends in all sizes from $\frac{1}{4}$ in. up to 2 in. bore and with flanged ends for $\frac{1}{2}$ in. up to 8 in. bore sizes. Depending on the service pressure requirements and nature of the duty the choice of materials includes cast iron, cast iron with acid-resisting enamel linings, cast steel, non-ferrous and stainless steels. The flap has a machined facing which when seated against the inlet spout acts as a non-return valve in event of back flow. The indicator can also be fitted vertically when flow is upward.

Heavy cast iron cover rings recessed to hold the glasses are bolted to both sides of the body and are located over spigots so that the glasses which are insulated around their periphery and clamped with $\frac{1}{32}$ in. Klingerit washers are completely enclosed at the edges and protected from metallic contact. Joint washers for special purposes made from lead sheet, Neoprene rubber, Fluon, etc., can be supplied, as also windows of Perspex or Polystyrene in place of toughened glass if required.

A group of Rhodes flap type indicators with graduated scale plates; the makers are B. Rhodes & Son Limited, Queen Street, Romford, Essex

Engineering Drawing and Drawing Office Practice. By P. S. Houghton. London, 1958; Crosby Lockwood & Sons Limited. 20/- net (by post 21/3). 227 pp. $5\frac{1}{2} \times 8\frac{1}{2}$ in.

The principal change in the second edition of this book is the addition of the requirements of B.S. 308:1953, which deals with the preparation of engineering drawings. These are discussed from the practical point of view, and not without criticism. The main body of the book is the substantial and thorough text as originally laid out, covering everything from the technique of draughtsmanship to its specialized application for different purposes as in making pipe drawings; drawing out gearing; making drawings of jigs, fixtures and tools; and drawings of press tools, castings and machine details. All these involve much knowledge of shop and foundry requirements, brought out in the text by explanations of how these practical needs are catered for in good drawings which enable a job to be carried through to completion without questions having to be raised. The author has a good deal to say also on drawing office organization and gives useful instructions on procedure for the checking and tracing of drawings. The books are very fully illustrated, mostly with line drawings of a style commensurate with the high standard of practical quality expounded in the text.

Automatic Measurement of Quality in Process Plants. London 1958; Butterworths Scientific Publications. 50/- net (by post 51/6). 320 pp. $5\frac{1}{2} \times 8\frac{1}{2}$ in.

It is not so long since that testing, even in continuously working plants, had to be done by taking samples to a laboratory, carrying out a test manually, and then transmitting the result to the plant where correction was made if necessary. The drawback of this procedure is very obvious: it lies in the time that elapsed between taking the sample and making the correction. In that time (indeed between the previous sampling and the subsequent indication) a change may have occurred which diminished the efficiency of the plant or impaired the product—in fact in some chemical processes it was quite possible for the product to have the wrong chemical composition. An important development in plant instrumentation in recent years has been automatic analysis or testing, sometimes continuously, of the stream through the process. The book under notice deals with a variety of devices of this kind. It contains the edited papers of the Society of Instrument Technology 1957 conference and is divided into six sections, each devoted to a particular technique. In some cases laboratory methods have been extended into plant instrumentation, as in the determination of alcohol in aqueous solution, apparatus for repeated analytical measurements, automatic distillation testing, and automatic means of determining the crystallizing point of solutions. In gas stream analysis developments include recording calorimetry, control of town's gas, measurement of Wobbe index, gas sampling, oxygen analysis, and the measurement of low humidity; and in liquid stream analysis there is control by measuring dielectric constant and acidity. Nuclear resonance, chromatography and the various spectrographic methods provide bases for several other ingenious methods. Some examples of the measurement of physical properties are included, notably viscometers, density meters and thickness gauges.

books

Die Zahnradpraxis. By K. F. Keck. München 1958; R. Oldenbourg Verlag GMBH. DM56 net. 404 pp. $6\frac{3}{4} \times 9\frac{1}{2}$ in.

The practice of gear design and manufacture covers a wide field which ranges from technical considerations of kinematics, load carrying capacity and performance to economic requirements and competitive cost.

Apart from the incorporation of gear wheels into complete drive systems the designers of gear wheels and pinions have to consider tooth profiles, pressures on and stresses in the teeth under load, gear noise, problems of manufacture and, of course, the cost of the finished article.

The book "Die Zahnradpraxis" by K. F. Keck, the second volume of which is being reviewed here, covers the whole field. Whilst the first volume has been concerned with spur gears, the second one deals with helical and bevel gears.

The three types of gears are treated under separate headings—helical gears, straight tooth bevel gears and spiral bevel gears. In each case the theory and kinematics of the toothed gear action, the discussion of profiles and profile corrections and the calculation of stress is followed by a description of manufacturing processes and their relative merits and by a chapter on inspection processes and procedures. Finally, a variety of excellent examples of gear calculations both with respect to the kinematics and the load carrying capacity enables the reader to appreciate the application of the principles described in the book. The author who is a recognized expert in the field, proves that he can put over in a masterly manner the sometimes difficult and complex problems involved.

The book is very well produced and the illustrations are excellent, and it can be strongly recommended to anyone who wishes either to study the subject or to apply the information in practice. A number of clear tables and graphs giving detailed information for use by designers and manufacturers adds to the usefulness of the book.—**F. Koenigsberger.**

Economic-type Boiler Defects and Repairs. A monograph of this title by Sydney D. Scorer has been published by John D. Troup Limited (90 High Holborn, London, WC1, 7/6 post free).

The economic boiler, particularly in its modern "packaged" form, is widely used and Mr. Scorer's concise and expert discourse on its proper maintenance will be welcomed by users of this type of steam generator. A notably useful feature is a four-page table relating the thickness of the furnace plate and the length between supports with safe working pressure.

Welding Research.—The British Welding Research Association (29 Park Crescent, London W1) has a large programme in hand concerning the various welding processes, weld testing, the properties of welds and welding materials, and some problems like brittle fracture. Engineering research has continued with a further full-scale frame test—a two-bay pitched roof portal. The association's annual report points out that economies made possible by the plastic method of design can be nullified if the weld sizes and connexions are designed by using conventional permissible stresses. Since in plastic design the only bending moments known are the fully plastic moments of the section

and not the actual moments produced by the loads at the point of connection, the designer has no choice but to design the joint for the full plastic moment. The conventional design method for connections will therefore produce welds which are too large. Similarly, foundations cannot be designed for anything but the full plastic moment. An investigation of multi-storey frames has shown that the observed instability is much smaller than might be expected from some theoretical treatments that have been put forward. The exact theoretical analysis of the problem is extremely difficult, but progress has been made in preparing a general programme for an electronic digital computor.

Water for Industry.—In the 1957 Edgar Manburg Lecture Mr. E. P. Partridge surveyed a problem which besets highly industrial countries—that of water supply. He deals with the problem as it is encountered in the United States, but there seems to be no detail which has not a parallel in the United Kingdom. He makes a plea for control of pollution to the extent where repeated re-use of water is possible: too often the first user of a stream renders it unsuitable for use by anyone else. With continued industrial expansion the problem is becoming acute and it is clear from the facts given by Mr. Partridge and other authorities that constructive study and action is overdue. Copies of Mr. Partridge's paper, entitled "Your Most Important Raw Material," can be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania, U.S.A., price $1·25 each.

Electricians' Pocket Book.—Measuring $4\frac{1}{2} \times 3\frac{5}{8}$ in., a little book for the pocket containing hints on the installation and maintenance of electric motors and generators has been issued by Higgs Motors Limited, Mitton, Birmingham 6, from whom it is obtainable price 2/-. It contains a specialized collection of practical information just such as the motor electrician requires for reference.

Quality Products.—Quality in the manufactured product is not something injected into it at a particular stage in manufacture: it has to be sought after all along the line right from design to the completion of production, and from selecting materials to imbuing everyone in the organization with the objects aimed at. The Research Committee of the Institution of Production Engineers has prepared a report on the subject, entitled "Quality—its creation and Control" which deals with the vital factors which must be recognized and understood if quality is to be secured, and particularly if it is to be obtained with economy. The report costs 10/- (by post 11/-) from the Institution of Production Engineers, 10 Chesterfield Street, London W1.

A.D.A. Publications.—The Aluminium Development Association has issued a Directory of Members, a List of Publications, and a List of Films, Film Strips and Wall Charts, all of which publications are available on request from the Association at 33 Grosvenor Street, London W1. The directory gives names, addresses and products of member companies; the publications list shows 23 Information Bulletins, 11 Applications Brochures, 34 Research Reports and 72 Reprints; and the film and chart list some 60, 16 mm, sound films as well as strips and charts.

Brit. I.R.E. Journal Abstracts.—The British Institution of Radio Engineers has published a new edition of "Selected Abstracts from the Journal of the Brit. I.R.E. 1946 to 1958". Some headings taken at random are: Astronomy, Nuclear Engineering, Magnetic Materials, Waveguides, Transit-time Tubes, Radiation Counters, Hearing Aids, Transmitters, Navigational Aids, Colour Television, Camera Tubes and Automatic Computors. This last section is particularly detailed, and 19 papers on all aspects of this important subject are listed. The arrangement of the abstracts is by subject according to the Universal Decimal Classification. Copies may be obtained from the Institution, 9, Bedford Square, London, WC1, price 3/6.

Readers Guide to Books on Mechanical Engineering.—A useful selection of titles from the extensive literature of mechanical engineering is provided in a 39-page guide published by the Library Association, Chaucer House, Malet Place, London WC1, price 1/- (by post 1/2): Theory, design, materials, organisation and the various power and machinery groups have their separate lists, including the principal specifications, and there is also a list of periodicals. The association has already issued guides to literature on electrical and automobile engineering and automation, and a guide on nuclear power engineering is in prospect.

Interfirm Comparison.—A management technique which is relatively new to Britain forms the subject of a new publication of the British Institute of Management (80 Fetter Lane, London, EC4). It is "Interfirm comparison for Management", by H. Ingham and L. Taylor Harrison, price 17/6 (by post 18/-). The technique provides a firm with a few key figures showing how its operating performance and financial results compare with those of similar firms in the same industry or trade.

Engineering Drawing.—The book on engineering drawing by A. C. Parkinson has been reprinted for a sixth edition. It is published by Sir Isaac Pitman & Sons Limited and the price is 9/- net (by post 10/-).

Table of Transport Integrals.—A table of integrals of the form

$$J_n(x) \equiv \int_0^x \frac{e^z z^n \, dz}{(e^z-1)^2}$$

has been prepared by William M. Rogers and Robert L. Powell, and is contained in National Bureau of Standards Circular 595, July 1958, 40 cents. Copies are obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, DC).

Modern theories of the transport properties of solids have progressed to the point where quantitative comparisons can be made between theory and the results of carefully controlled experiments. Transport integrals of the form tabulated in this circular occur frequently in the theories, especially for electrical resistance, thermal conductivity, and specific heat.

These tables give values of the integral to six significant figures for the index integer n from 2 to 17, and for the limit of integration x, by 0·1 intervals, from 0·1 to the upper limiting value which ranges from $x=25$ for $n=2$, to $x=40$ for $n=17$.

Derivations of the three series utilized to represent the integral in different ranges are given. Also included are the limiting values in the upper range, the asymptotic series expansions in the lower range, and tables of the Riemann Zeta numbers and Bernoulli numbers utilized in the calculations.

"Unaccustomed as I am—

. . . Yet 4 weeks Later He Swept Them Off Their Feet!

In a daze he slumped to his seat. Failure . . . when a good impression before these men meant so much. Over breakfast next morning his wife noticed his gloomy, preoccupied air.

"What's the trouble, dear?"

"Oh . . . nothing, I just fumbled my big chance last night, that's all!"

"John! You don't mean that your big idea didn't catch on!"

"I don't think so. But Great Scott, I didn't know they were going to let me do the explaining. I outlined it to Bell—he's the public speaker of our Company! I thought he was going to do the talking!"

"But, dear, that was so foolish. It was your idea—why let Bell take all the credit? They'll never recognise your ability if you sit back all the time. You really ought to learn how to speak in public!"

"Well, I'm too old to go to a class now, and besides, I haven't got the time!"

"I've got the answer to that. Where's that magazine? Here—read this. Here's an internationally known institute that offers a home study course in effective speaking. They offer a free book entitled *How To Work Wonders With Words*, which tells how any man can develop his natural speaking ability. Why not send for it?"

He did. And a few minutes' reading of this amazing book changed the entire course of John's business career. It showed him how a simple and easy method, in twenty minutes a day, would train him to dominate one man or thousands—convince one man or many—how to talk at business meeting, lodges, banquets and social affairs. It banished all the mystery and magic of effective speaking and revealed the natural Laws of Conversation that distinguish the powerful speaker from the man who never knows what to say.

Four weeks sped by quickly. His associates were mystified by the change in his attitude. He began for the first time to voice his opinions at business conferences. Fortunately, the opportunity to resubmit his plan occurred a few weeks later. But John, this time, was ready. "Go ahead with the plan," said the Managing Director, when John had finished his talk. "I get your idea much more clearly now. And I'm creating a new place for you—there's room at the top in our organisation for men who know how to talk!"

And his newly developed talent has created other advantages for him. He is a sought-after speaker for civic, banquet and lodge affairs. Social leaders compete for his attendance at dinners because he is such an interesting talker. And he lays all the credit for his success to his wife's suggestion—and to the facts contained in this free book—*How To Work Wonders With Words*. For twenty-five years the Speakers' Service has been proving to men that ability to express oneself is the result of training, rather than a natural gift of a chosen few. Any man can absorb and apply quickly the natural Laws of Conversation. With these laws in mind, the faults of timidity, self-consciousness, stage-fright and lack of poise disappear; repressed ideas and thoughts come forth in words that sparkle with brilliance, charm and power.

Have you an open mind? Then send for this free book *How To Work Wonders With Words*. Over 100,000 men and women in all walks of life have found in this book a key that has opened a veritable floodgate of natural speaking ability. See for yourself how you can become a popular and dominating speaker Your copy is waiting for you—free—simply for the posting of the coupon.

Send for this Amazing Book

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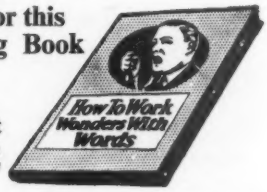

THE SPEAKERS' SERVICE (Dept. MEC/ES3)
Marple, Cheshire

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(Dept. MEC/ES3) MARPLE, CHESHIRE

Please send me my FREE copy of your inspiring book, *How To Work Wonders With Words*, and full details of your methods of speaking effectively. I enclose 3d. stamp for postage.

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BUSINESS & PROFESSIONAL

Personal

CHARLES CHURCHILL COMPANY LIMITED, Birmingham, have announced the retirement of two of their senior employees. **Mr. David Nicholson** late sales manager, engineer supplies division at the Birmingham headquarters of the company—Mr. Nicholson joined the company in 1929; and **Mr. "Donal" Cameron,** late Scottish area sales manager.

WINSTON ELECTRONICS LIMITED announce the appointments of four regional technical sales engineers as follows: **Mr. K. P. Reynolds, M.I.E.E.,** Manchester, will cover Yorks., Lancs., Cheshire and the North; **Mr. Pheevey, B.Sc.(Eng.),** Birmingham, will cover the Midlands, **Mr. V. H. A. Diederichs,** London and counties south of the Thames and **Mr. D. A. Jamieson** will cover the London area and counties north of the Thames.

Mr. E. Player, deputy chairman and managing director of Birmid Industries Limited and a director of Midland Motor Cylinder Company Limited, and **Mr. F. A. W. Livermore,** who has for the last 5 years been works director of the latter company, have been appointed joint managing directors of the Midland Motor Cylinder Company Limited.

Mr. John Parsons, B.Com.(London), M.B.A. (Harvard) has been appointed to the board of directors of Richard Lloyd Limited, Birmingham and Tenbury Wells. He was formerly assistant general works manager of Rolls Royce Limited, Derby.

Mr. A. P. M. Purdon has been appointed operations study manager in charge of central operational research and work study for the British Oxygen Company Limited.

EDGAR ALLEN & CO. LIMITED announce the following appointments in their engineering department: **Mr. J. Higginbotham** as deputy general manager, after service in the accounts department and on the staff of the foundry manager. **Mr. J. D. Studholme** as assistant general manager. **Mr. A. Brunton** as commercial manager. **Mr. A. Wallis** as chief draughtsman (Production). **Mr. J. D. Lee** as chief draughtsman (Development). **Mr. S. Carter** as chief estimator.

BIRFIELD INDUSTRIES LIMITED announce the appointment of **Mr. G. W. Kelland, A.M.I. Mech.E., Assoc. Inst.T.,** as public relations officer of the Birfield Group.

Mr. Peter Liddell has been appointed general manager of the Dunlop Rubber Company (Indonesia) Limited, and has now taken up his post. Mr. Liddell spent nine years in Malaya between 1947 and 1956 in various capacities with Dunlop.

Mr. C. R. Atkins, O.B.E., stores superintendent, Scottish Region, British Railways, retired on August 31 last. He entered the service of the London and North Western Railway at Crewe in January, 1913, in the Department of the Mechanical Engineer, later transferring to the Stores Department. Mr. Atkins served in both world wars, being posted in 1940 as staff captain to the War Office on Transportation Technical Supply, and subsequently promoted D.A.D. Tn (Stores).

Sir Leonard Sinclair has been appointed a part-time member of the British Transport Commission.

REMINGTON RAND LIMITED recently announced that **Mr. G. McLean** was relinquishing his position of secretary and director to take up a post with the American parent organization—the Sperry Rand Corporation; and that **Mr. J. S. Chalmers,** the company's chief accountant, had been appointed secretary and controller of the company.

Mr. Roy A. Wykes has relinquished his directorship of Taylor Woodrow (Nigeria) Limited, on his recent appointment as vice-president and managing director of the interests in Canada of the Taylor Woodrow group of building and civil engineering companies. His new responsibilities include the vice-presidency of Monarch Mortgage and Investments Limited, its subsidiary, Monarch Construction and Realty Limited, and Taylor Woodrow (Canada) Limited.

Mr. W. L. Baker, manager of the Metal Finishing Division of The Pyrene Company Limited, retired in September after 30 years service with the company. He is succeeded by **Mr. H. A. Holden, M.Sc., A.R.C.S., D.I.C., A.I.M.,** who has had many years experience in the division. **Mr. H. F. Parshall, M.A., T.D.,** who has been with the company for some twenty years, continues as director in charge of the division.

DUNLOP RUBBER COMPANY LIMITED announce the retirement of **Mr. W. G. ("Bill") Goff,** personnel manager at Fort Dunlop since 1945. Mr. Goff joined Dunlop as a wages clerk at the age of 21. He recalls that the first weekly wage bill at the Fort Dunlop factory in 1916 came to £8 14s. 6d, shared among three people. To-day this same factory is the largest rubber manufacturing plant in the British Commonwealth with a weekly wage bill of about £118,000.

Mr. T. P. W. Norris, lately chief personnel officer of the Vickers Group and a former president of the Institute of Personnel Management, has been appointed a director of George Kent Limited. **Mr. R. E. Hanford, B.Sc.,** deputy managing director, has relinquished his executive functions but retains his seat on the board. Mr. Handford has a total of 45 years' service with the company, 25 of which as a member of the board. **Mr. W. A. Hartop** has been appointed managing director; he joined the company in 1927 and was appointed to the board in 1943. **Commander P. W. Kent,** formerly chairman and managing director, remains as chairman. The retirement of two directors is also announced—**Mr. W. Guy Ardley,** Hon. Member Inst. of Water Engineers, who joined the company in 1893 and became a director in 1914, and joint managing director 1938-1956; and **Mr. Leslie H. Kent, A.M.I.C.E., M.I.Mech.E., R.B.A.,** who joined the company in 1913, and the board in 1915.

Mr. C. E. Roebuck has been appointed chief estimating engineer of the newly-created engineering estimating department at Steel, Peech and Tozer, a branch of the United Steel Companies, Limited. **Mr. D. E. Barker** succeeds Mr. Roebuck as chief planning engineer.

Mr. J. Peter Ford has been appointed managing director of Coventry Climax Engines Limited new export company now in process of formation.

Obituary

WE regret to record the death of **Sir Frederick Charles Yapp** at the age of 78. Sir Frederick joined the Ordnance Department of Vickers Sons & Maxim Limited in January 1902 and when he retired from the board of Vickers Limited on June 5 1951 he had completed just under fifty years service with the Vickers Group. During that time he had been a director of many of the group companies including chairman of Vickers-Armstrongs Limited from 1944 to 1946.

WE regret to record the death of **Mr. Frederick Osgood Hickling,** technical manager of Ransome and Marles Bearing Company for the past thirty years. There are engineers all over the world who knew Mr. Hickling as Fred and respected his knowledge. He was not only an authority on ball and roller bearings and their application, but possessed a deep and instinctive understanding of sound engineering practice applied to any mechanical

3T CORD

Exclusive Goodyear development means stronger, thinner, more flexible transmission belting.

No splice failure
In construction the cord is wound continuously around two pulleys to produce a truly endless belt.

No ply separation
The single layer of load carrying cords round the pulley together, preventing internal stress.

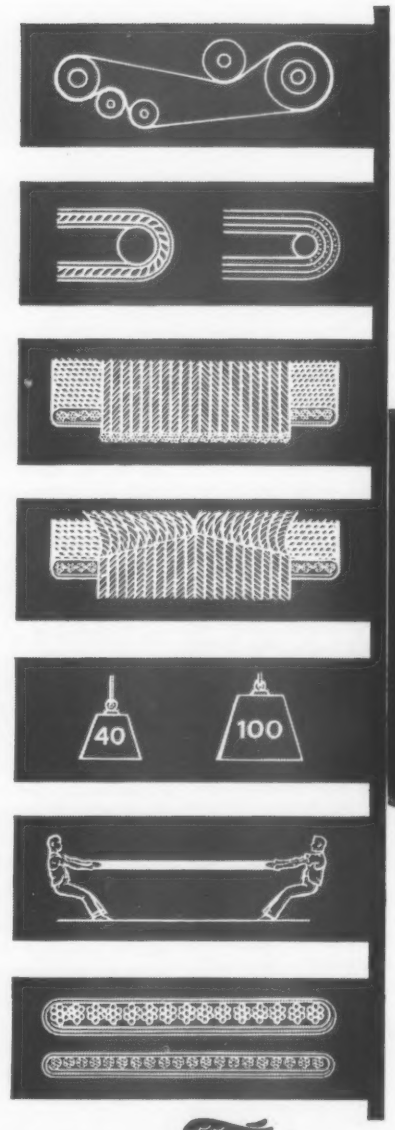
Less lateral movement
To neutralize lateral movement half the cords are twisted to the right and half to the left.

Elastic envelope
Designed to provide high friction surface to grip the pulley and transfer load to the cords.

Stronger 3T Cord
2½ times stronger than cotton and each filament of fibre is continuous, like the cord itself.

Less stretch
Triple Tempering removes surplus stretch but only to a degree where it does not hinder the flexibility of the fibre.

Thinner belt
3-T Cord belt is 25% thinner than belts of equal horse-power rating.



THE amazing new Goodyear 3-T cord process – successfully applied to motor car and commercial vehicle tyres – is also making transmission belts work harder, last longer and cost less for a given horsepower rating.

The synthetic cords are 'triple-tempered' – passed through a process at a controlled Tension and Temperature for a specific Time – to give them maximum strength and flexibility, minimum stretch. The result is that you can use a thinner belt – get improved flex life, longer wear, more efficient transmission and reduced maintenance.

There's a Goodyear 'job-designed' transmission belt for every drive . . . every duty.

NEW HD ENDLESS CORD BELT

The synthetic 3-T cords are *2½ times stronger* than cotton. This means longer service at lower cost on any drive. The special design of the belt eliminates splice failure and ply separation. HD Endless Cord costs no more, yet you get much higher horsepower ratings, better service all round.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

Transmission Belting
Conveyor Belting · Hose
V-Belts · Industrial Fenders

THE GOODYEAR TYRE & RUBBER COMPANY (GREAT BRITAIN) LIMITED, WOLVERHAMPTON

design. During his last few months Mr. Hickling showed a quite extraordinary determination to ignore his ill-health and carry on his job to the ultimate limit of his capacity. His many friends will miss his puckish grin and ready appreciation of their own engineering design problems.

We regret to record the death, after a prolonged illness, of **Mr. E. G. Pickering**, a joint managing director of Johnson, Matthey & Company Limited.

Addresses

The Hoffmann Manufacturing Company Limited, Chelmsford, have moved their Glasgow office and stockroom to larger premises at 75 Robertson Street, C2. Telephone CENtral 0468/9; Telex No. 77523. Telegraphic address "Hoffmann Glasgow Telex". Mr. R. M. Spiers is the engineer-in-charge.

Activated Sludge Limited have changed their address from 96, Victoria Street, SW1 to Abbey House, Victoria Street, Westminster, London, SW1. Telephones ABBey 2012/3. Telegrams Acsludgeti, Sowest, London.

A new depot at Oakcroft Road, Chessington Surrey, has now been opened by British Insulated Callenders Cables Limited (telephone Lower Hook 2323). Mr. H. M. Hudson will be in charge of the new depot.

New showrooms and offices, designed to serve as a base for the company's European operations, have been acquired by Pressed Steel Company of Cowley, Oxford, in Brussels. The new premises, which are in the Galerie Ravenstein, were officially opened on September 16 by M. Longerstaey, Chef de Cabinet to the Belgian Minister for External Trade.

In order to provide for future expansion, Acheson Industries (Europe) Limited have now moved their London offices to the new building at 1 Finsbury Square, London EC2. Telephone Monarch 5811 (4 lines). Telegraphic address: Oildag, Stock, London. Cables: Oildag, London.

New Export Company

A new company called A.E.I.–Gala Limited to be a direct subsidiary of A.E.I.–Hotpoint Limited has been formed to handle the export of domestic appliances previously carried out by Hotpoint (including their Coldrator and Premier divisions) and by the B.T.H. Export Company acting as agents for Hotpoint. The board of the company will consist of Mr. R. Craig Wood (chairman), Mr. D. T. L. Rettie and Mr. B. W. Burnett. The principal executive officers are Mr. F. R. de G. Hewitt, who has been appointed manager, Sales division, and Mr. C. E. Cannell, who has been appointed manager, marketing division.

Film News

The manufacture of rims and wheels is the subject of the latest Dunlop film, particularly the developments through the use of automatic techniques. The film runs for 14 min and is entitled *Progress in Wheel Manufacture*. Produced by the Dunlop Technical Film Unit at the Company's Coventry factory, the film is now obtainable on free loan from The Dunlop Film Library, 269 Kingston Road, Merton Park, London SW 19.

The Brook Film Unit have recently released a new 15 minute colour film "More For Your Money", which is rather more technical than their previous efforts. The film introduces a new design of electric motor, the 'C' type to B.S. 2960:1958. A running sectioned model enables the many improvements in the internal design and the central ventilation method to be easily explained. The new motors conform to the American NEMA rerate standard and to the CEMA standard for Canada. Assembly conveyors in the Huddersfield Works and the stock areas for the new motors are featured and the film concludes with the offer of technical advice on the application of the new motors with the backing of the Brook world-wide system of service representatives.

British/U.S. Nuclear Handling Company

The British partner in the new jointly owned British-American nuclear handling company is Savage and Pearson Limited, Watford, Herts. This company's mechanical Master Slave manipulators, remote handling tools, lead shielding bricks, and other equipment are widely used in all U.K.A.E.A. establishments, and the company also has extensive export business.

The second partner is the Mechanical Division of General Mills, Inc., (Central Avenue, Minneapolis 13, Minnesota), pioneers in the design and manufacture of heavy duty powered manipulators and reactor fuel charging systems since 1948, and the first commercial firm in the world to enter this field. Within the past twelve months there has been an increasing demand for their nuclear equipment from overseas countries, and this is one of the reasons behind the formation of the new company.

Moog Valves Licence

Arrangements for the manufacture in the United Kingdom of the Moog Servo valve have been made by Dowty Equipment Limited of Cheltenham with Moog Valve Company Incorporated of New York, U.S.A. The agreement covers the U.K., British Commonwealth (excluding Canada) and Western Europe.

Contracts and Work in Progress

Short Brothers & Harland Limited and the Bristol Aeroplane Company of Canada Limited are jointly concerned in the supply of a short general purpose analogue computor to McGill University, Montreal, for research purposes.

National Free Piston Power Limited. Contract worth £500,000 for a free piston gas turbine power plant for Finland. The free piston gasifyers will be manufactured by National Gas and Oil Engines Company Limited of Ashton-u-Lyne and the gas expansion tubes and alternators will be made by the Brush Electrical Engineering Company Limited, Loughborough.

Fairey Aviation Company Limited. Fairey Rotodyne vertical take-off air liner for the Okanagan Helicopter Group of Vancouver for use by the Group on passenger services between city centres in Canada. Delivery two to three years. With a fleet of 54 helicopters, Okanagan are the largest commercial helicopter operators in the world.

E.M.I. Electronics Limited. Orders worth more than one million dollars for advanced type airborne radar equipment for the Royal Canadian Air Force.

Crowthorn Engineering Company Limited. Order recently completed for three Crowthorn 7½ in. centre lathes on 7 ft 3 in. gap bed, admitting 3 ft 6 in. between centres, complete with motor drive and other equipment, for the engineering department of the Sheffield College of Technology.

Automatic Telephone & Electric Company Limited. Post Office order for a wide band coaxial telephone system between Cardiff and Bristol, enabling the capacity of existing cable under the Severn to be almost trebled.

Three orders (two for overseas) for radio channelling equipment worth almost £250,000.

Gresham Transformers Limited, Hanworth, Mdx. Contract for four step-down transformers, fitted with Metropolitan-Vickers automatic on-load tap changing equipment, for the Electricity Board of Northern Ireland.

Order for auxiliary transformers for the 132kV substation at the Bradwell-on-Sea, Essex, atomic energy generating station of the Central Electricity Generating Board.

Permatred Flooring

To avoid confusion with the trade name of a roofing material the heavy duty densified wood flooring material manufactured by Permali Limited is now being registered as "Permatred" in place of "Permadec".

Non-destructive Testing

IN July last Gammax Limited, London, specialists in non-destructive testing, established a new radiographic inspection service, for the examination of welds, castings and machine components. Field inspection engineers are available for on site operations and laboratory testing facilities are provided. The company manufacture a range of Gamma and X-ray equipment and accessories. The non-destructive inspection service is under the personal supervision of R. J. Ford, A.N.D.T.S.

Machine Tool Companies Co-operate

AN agreement between the Mortimer Engineering Company and Stanhope Machine Tools Limited is now operating for the sale and servicing of the two companies' ranges of machine tools and equipment. Stanhope Machine Tools have taken new offices and showrooms at 202 Acton Lane, Harlesden, London NW10—adjacent to Mortimer Engineering Company's premises at 204–6 Acton Lane. The telephone number is Elgar 3834.

Brockhouse Development in Africa

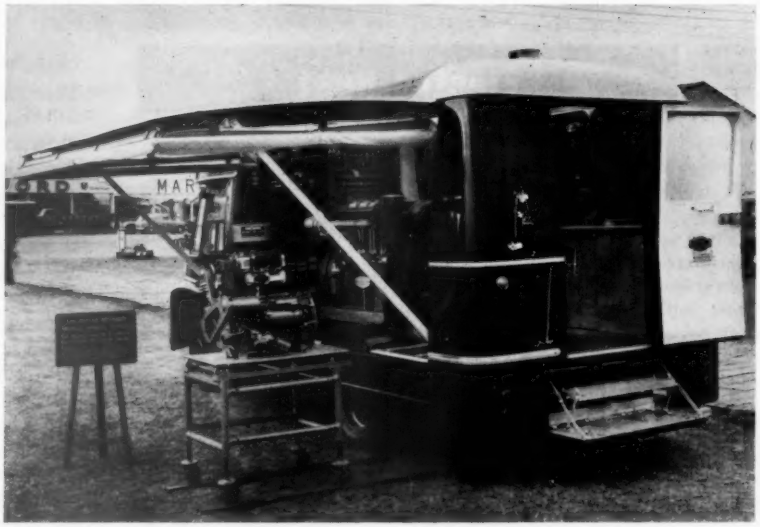
J. BROCKHOUSE & CO. LIMITED in conjunction with W. G. Allen & Sons (Tipton) Limited, have formed a joint company to be known as Brockhouse Allen Limited, in the Federation of Rhodesia and Nyasaland. The new company will operate from factories acquired from J. Brockhouse (Rhodesia) Limited, in Ndola and Luanshya and will produce engineering requirements for the mining and transport industries. W. G. Allen already have an established connexion with the coppermines. J. Brockhouse (Rhodesia) Limited will continue to act as a separate entity in Southern Rhodesia, where their main products are steel bodies, trailers, dumpers and sheet metal fabrication.

Export of Steel Scrap

THE Board of Trade recently expressed its willingness to consider applications for licences to export limited quantities of iron and steel scrap. Applications stating grade, f.o.b. price and details of the firm order for the material, including the method and terms of payment, should be made to the Export Licensing Branch, Board of Trade, 2/14, Bunhill Row, London, EC1. on Form (F).

T.V. Camera and Equipment Hire Service

PYE LIMITED are now operating a television hire service. The service, which will include technical and production facilities, will enable customers to call upon any form of TV apparatus ranging from outside broadcasting vans or underwater television cameras to a single miniature industrial TV camera and monitor. The service will not be confined to closed-circuit television. It will include, if necessary and practicable, the operation of microwave links over long or short distances and free consultancy on TV communications problems.



SERVICE INSTRUCTION VEHICLE.—The new Petter McLaren Mobile Service School is now ready for service instruction. It is designed for lectures and demonstrations on all servicing problems on Petter engines and is available to service depots, local agents, or educational associations. All fittings are designed for easy removal so that instruction can be carried out in a classroom as well as from the van itself. The sectioned engines can easily be removed in the same manner. The special coachwork was built by W. S. Yeates Limited, of Loughborough to Petter McLaren's own design. The chassis is the latest Austin two-ton fitted with a BMC diesel engine

Refresher Course for Plant Engineers

ARRANGED by Incorporated Plant Engineers, and designed to encourage the most effective use of existing knowledge and to promote the application of up-to-date techniques in works engineering practice over a broad field, the purpose of the new refresher course at Liverpool University is to help works and plant engineers to make the fullest possible contribution to increasing productivity. The fee for the course is four guineas and copies of the syllabus and full particulars may be obtained from the Secretary to the Refresher Course at The Donnan Laboratory, Vine Street, Liverpool 3. (Telephone ROYal 6022).

A. Herbert's New Agency

PLANERS (HUDDERSFIELD) LIMITED, manufacturers of planing machines and equipment, have appointed Alfred Herbert Limited of Coventry as sole selling agents in the United Kingdom and Eire. Customers' specific requirements can be met.

Brook Canadian Subsidiary

BROOK ELECTRIC MOTORS of Canada Limited formed as the Canadian subsidiary of Brook Motors Limited have now begun business from their offices at 250 University Avenue, Toronto. Director and vice-president of the new company is Mr. A. E. Hogton of the Brook American subsidiary in Chicago and formerly at Huddersfield. Mr. H. W. Lumb and Mr. R. Booth have both left the British organization to take over sales in Canada.

'Araldite' Price Reductions

THE completion of their new epoxy resin factory at Duxford, Camb, and the consequent increased production capacity have enabled Ciba (A.R.L.) Limited (formerly Aero Research Limited) to make substantial price reductions for their 'Araldite' epoxy resins.

BTH Price Reduction

A reduction of 10% in the prices of Schrage motors has been made by the British Thomson-Houston Company Limited.

Incandescent New Division

THE INCANDESCENT HEAT COMPANY LIMITED of Smethwick has formed a Gas Atmospheres Division under Mr. I. L. S. Golding, to co-ordinate the Incandescent Groups activities in this field.

Erratum

"Recent Research into Stainless Steels".— In the article of this title which appeared in our September issue, the word nickel should have been included after the percentage value 3.5 to 4.5 (p. 405, col. 2, para. 2, line 2).

Electro-Heat

The ways in which electricity can be used to advantage in industry are many and varied. Some are well known but others are not known well enough. For this reason the Electrical Development Association has prepared a series of detailed data sheets on various applications which will be printed in this journal from time to time.

This Data Sheet is the first of a number devoted to electro-heat–that is, heat produced by electricity for the processing and treatment of materials. Other uses will be dealt with later on in the series.

There is an unalterable physical law that the efficiency of conversion of *electrical* energy to *heat* energy is 100 per cent. The same cannot be said of the efficiency of combustion of any solid or liquid fuel.

All the applications of electro-heat have these advantages in common :—

1 Electro-heat is clean both in regard to its application and the method of generation.

2 It can easily be controlled more precisely than any other form of heat, manually or automatically.

3 It can be brought to the job instead of having the job brought to it.

4 It permits better use of floor space and the elimination of unnecessary handling.

5 In many of the newer processes it is the only possible form of heat which can be used.

6 It often ensures a higher quality of products with fewer rejects.

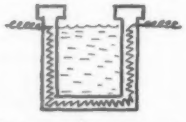
7 It gives the best working conditions.

8 It reduces or eliminates fire and explosion hazards.

Below will be found brief notes on some of the various methods of generating heat by electricity.

Resistance Heating

This is the best known form of electric heating. The elements provide a high resistance to the passage of electricity and thus heat is generated. It can be used in furnaces for melting or heat treatment of any material whether metal or not, or the resistance of the workpiece itself can cause the generation of heat.

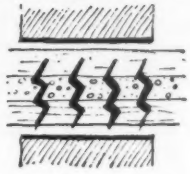


Induction Heating

Eddy currents are induced in the surface of a conducting workpiece, heating it up. The depth to which this heating will penetrate is determined by the time it is given.

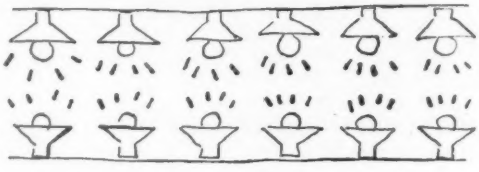
High-frequency Dielectric Heating

This form of electro-heat can be used only on non-conducting materials such as wood, plastic and rubber. The material is placed between two electrodes to which a high voltage is applied at a high frequency. This has the effect of generating heat inside the material rapidly and uniformly throughout its entire thickness.



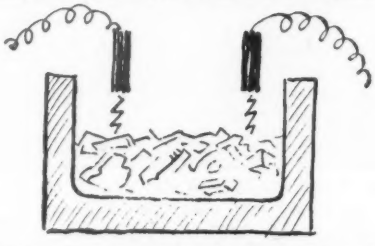
Infra-red Heating

This method employs pure radiant heat. The bulk of the radiation takes place in the infra-red portion of the radiation frequency spectrum. The heaters may take the form of reflector lamps or sheathed wire elements. The method is extremely flexible and has many uses, including paint drying and pre-heating plastics.



Arc Melting

This form of heating is chiefly used for melting steel. The diagram illustrates one method of operation.



Very large charges can be melted; melting units of 200 tons capacity are now in operation.

The Application of Electro-Heat

All these methods of electric heating can be applied in almost an infinite variety of ways. Some of these ways will be dealt with in subsequent sheets.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2.

Excellent reference books on electricity and productivity (8/6 each or 9/- post free) are available—"Induction and Dielectric Heating" is an example; "Resistance Heating" is another.

E.D.A. also have available on free loan a series of films on the industrial use of electricity. Ask for a catalogue.

Trade Literature

Storage Bin Units

A range of storage bins of three types and suitable for most applications is announced in a new leaflet from Pegson Limited, Coalville, Leics.

Square, fixed units are offered in a choice of four basic designs with heaped capacities ranging from 45 cu yd, or 55 ton to 106 cu yd, or 130 ton. Designed to form the basic part of a fixed plant storage section, they will support overhead equipment such as screens, conveyors, etc.

Round type, fixed units provide self-contained storage sections and are available in diameters of 14 ft and 20 ft. Single or double tiers can be supplied to give capacities ranging from 53 cu yd, or 65 ton to 163 cu yd, or 200 ton, heaped.

Semi-portable type units designed for easy erection are available, with 20 ton or 30 ton heaped storage capacity (16 or 24½ cu yd).

Screening for Finishing Processes

Outlined in an illustrated leaflet the Dust Barrier method of dust exclusion depends upon the use of simple screens of dust absorbing material to reduce dust penetration in the workshop or specific areas. Dust barrier material is of open weave and is impregnated with a non-drying adhesive. It does not impede light or ventilation to any appreciable extent and the support framing permits constructions up to 15 ft wide and of any length. The method has been developed by Anti-Dust Services Limited, Dudley, Worcs.

Machine Tool Rebuilding

Details of the complete machine tool reconditioning service offered by J. Brockhouse & Company Limited, Elms Works, Wolverhampton is shown in a new colour folder.

Drilling Machine Compound Table

A low-priced compound table has been produced for use on drilling machines for centring, multiple-hole drilling, vertical milling and keyway cutting etc., by Lorant & Co. Limited, 98-100 Croydon Road, London, S.E.20.

The table top measuring 12½ in × 6½ in. is a precision ground Meehanite casting with a front edge register face and it is mounted on a central slide and broad heavy base for maximum stability.

Full details of the table which is priced at £59 10s. are given in leaflet CS.143.

Wire-wound Heat Transfer Tube

A claim to have produced the most efficient heat transfer tube with extended surface is made by Clayton Dewandre Company Limited, Titanic Works, Lincoln for their Clayton-Still spiral wire wound tube. Its large dissipating surface is formed by a continuous wire wound in elongated loops. Each loop is firmly soldered to the basic tube, the fillet forming the thermal contact between the two. Full details of the construction, materials and sizes available are contained in an illustrated brochure issued by the makers.

Fabric Dust Filters

The Dallow Lambert Drytube filter, a fabric sleeve type filter for dry dust removal, is shown in a new folder No. 58 from Dallow Lambert & Company Limited, Thurmaston, Leics. They are made in three types and a standard range of sizes and dust removal is by quick release bins or worm conveyors. Hand operation or automatic shaking gear can be fitted.

Pumps for Hydraulic Systems

A four page catalogue describing the operation of the Pesco variable displacement internal-external pump (VIEP) is now available from Pesco Products Division, Borg-Warner Corporation, Bedford, Ohio, U.S.A.

The pump which has only two major moving parts is primarily intended for use in high speed, high temperature systems.

Cheaper Surface Grinders

A price reduction of 5% affecting all surface grinders manufactured by Beacon Machine Tools Limited, Hurst Lane, Tipton, Staffs, has been announced. Suitable for toolroom or production work these machines as described in leaflets 36 and 37a are available with alternative grinding head bearing arrangements—plain, ball bearing and Timken taper roller bearings.

Wood Chipboard

Information on the use of Plimber wood chipboard for interior building construction is contained in a new brochure published by British Plimber Limited, Rainham, Essex. The standard board size is 8 × 4 ft in two thicknesses ½ and ¾ in. The boards are also available in all grades in lengths up to 16 ft × 4 ft wide.

Tool Steels for Cold Work

A booklet outlining the properties of the principal brands of K.E. alloy tool steels has been issued by Kayser Ellison and Company Limited, Carlisle Works, Sheffield 4. It is well produced and contains detailed information as to the correct forging, annealing and hardening techniques to be employed for each particular steel.

Isolating Vibration and Shock

An informative booklet No. 957, on vibration problems has been published by W. Christie & Grey Limited. 4 Lloyds Avenue, London EC3. The fundamental theory of vibration isolation is discussed followed by numerous illustrated examples of spring suspension systems, rubber unit mountings and viscous dampers.

Pneumatic Gauging Equipment

Air gauges, their principle of operation, description and application both on the shop floor and the inspection room are the subjects dealt with in the latest catalogue from Teddington Industrial Equipment Limited, Sunbury-on-Thames, Middx.

Multi-vane and Paddle Blade Fans

The fourth edition of the Cyclone fan catalogue has been published by Matthews & Yates Limited, Cyclone Works, Swinton, Manchester. Its contents include slow speed, medium speed multi-vane fans, paddle blade and P.V.C. fans and a wealth of technical data necessary for selecting the appropriate fan for any ventilation installation.

Hand and Clothing Monitor

A new folder on the hand and clothing monitor Type I has been produced by E.M.I. Electronics Limited, Hayes, Middx.

The instrument provides simultaneous detection of both alpha and beta contamination of the hands, reducing the hand count time to 5 sec. Audible and visible warnings are given should the user be contaminated in excess of the permitted level.

New Factories

Birtley (Co. Durham). H. N. Marsh & Co. Limited, Fourth Avenue, Gateshead. Direct labour is to be employed on the erection of offices at Birtley.

Blaydon-on-Tyne. The Logan Engineering Company are to extend their factory in Patterson Street. The contract has been let to the Alston Limestone Company Limited, Westgate Road, Newcastle upon Tyne.

Chester-le-Street. Graves (Bakers) Limited, Chester-le-Street are to erect bakery, garage, and offices at Birtley. The architect is H. A. Young, 37 Eccleston Square, London SW1.

Consett. Thomas Swan & Co. Limited, tarmacadam manufacturers, are to erect a slag processing plant.

Darlington. Underground Mining Machinery Company Limited, Aycliffe trading estate. Factory additions proposed. The architects are Fennell and Baddiley, Bridge End Chambers, Chester-le-Street.

Durham. Durham County Water Board, Neville Court, are planning the construction of a £200,000 filter plant at Muggleswick Common. Work is expected to start soon. The Boards' chief engineer is Mr. A. C. Wildsmith.

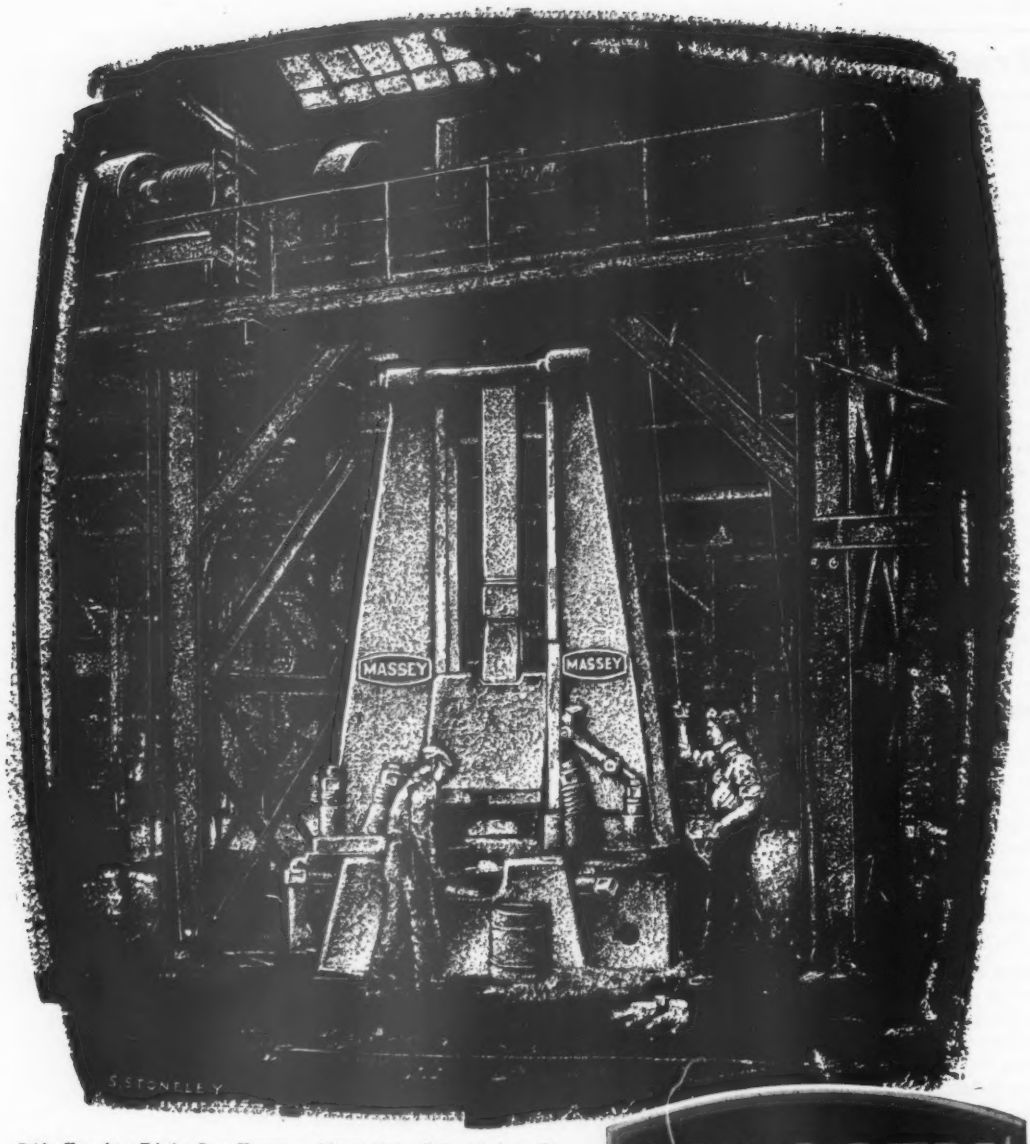
Eaglescliffe (Co. Durham). British Chrome and Chemicals, Limited. Plans have been approved for additions covering about 10,000 sq ft. The contractors are Dunlop and Ranken, Limited. Leeds.

Gateshead. W. B. Marks and Son, Limited Newcastle upon Tyne are to erect warehouse in Saltmeadows Road, Gateshead. The architects are Glover and Partners, Frances Street, London, SW1.

Hebburn. Jackson, Harding and Company Limited, steel stockists, etc., Swindon Street, are to extend their storage accommodation.

George Angus & Co. Limited. Factory extension proposed. The contractors are Shields Brothers, Swalwell.

Newcastle upon Tyne. The City Council is being recommended to acquire com-



Bridge Type 4 ton Friction Drop Hammer at Messrs. Kirkstall Forge Ltd., Leeds.

cut costs with . . . MASSEY

Massey Friction Drop Hammers, Bridge Type, are made in a range of sizes from 10 cwt. to 16 tons capacity and are capable of producing forgings of the most intricate design at high production speeds. Ease of control and adaptability, coupled with low operating and upkeep costs, make them the obvious choice for any general forge.

Massey designs include:
Steam and Compressed Air Hammers,
Pneumatic Power Hammers,
Friction Drop Hammers,
Double-acting Steam and Compressed Air Drop Hammers, Forging Presses, Trimming Presses,
Tyre Fixing Rolls.

B. & S. MASSEY LTD. OPENSHAW · MANCHESTER · ENGLAND

MAKERS OF THE WORLD'S GREATEST RANGE OF FORGING PLANT

pulsorily a 19 acres site in the Blandford Street area for a proposed industrial site. The City Engineer is Mr. P. Parr.

James Blair and Sons are to erect warehouse, offices and garage in Blandford Street to plans by C. Solomon, 30 St. Mary's Place, Newcastle.

Guildhall Motors Limited. Plans for an automobile service station at Sandhill are being prepared by R. Wood, 14 The Grove, Gosforth.

J. Sharff & Co. Limited, Westmorland Road, propose warehouse and offices in Blenheim Street, to plans by Waring and Netts, Jesmond Road, Newcastle.

North Shields. Smiths' Dock Company Limited. Plans have been approved for rebuilding Shields Engineering Jetty. The contractors are J. G. Thompson and Sons (Contractors), Limited, 28 Fowler Street, South Shields.

Peterlee (Co. Durham). Peterlee Development Corporation, are to erect a £30,000 factory which will be let to the Peterlee Wood Wool Co. Ltd.

Stanley (Co. Durham). Durham Coal Board (No. 6 Area), Shotley Bridge, are to convert a building at the Louisa Pit, Stanley, into laboratories of about 10,000 sq ft. The board have prepared their own plans.

Atkinson and Sons, Chester-le-Street. Extensions covering about 8000 sq ft are proposed at South View Garage. The work will be done by direct labour. The architects are Fennell and Baddiley, Bridge End Chambers, Chester-le-Street.

Stockton-on-Tees. Modern Laundries, Limited. Offices and garage. R. Cowan, 20 Finkle Street, Stockton, architect.

Metallisation, Limited, Dudley, Worcestershire to erect offices and factory covering 7,000 sq ft and are preparing their own plans.

Daralum Castings Limited, Darlington are seeking a site of about two acres on the Portrack Lane Estate, for factory purposes.

Richmond Construction Limited, constructional engineers, West Hartlepool, are to erect workshop and offices on the same estate.

Kennedy and Company, Maritime Street, are to extend their factory in Commercial Street.

British Chrome and Chemicals Limited, Eaglescliffe. Plans have been approved for further extensions of about 10,000 sq ft.

Isaac Robson & Co. Limited, builders' merchants. Additions are proposed in Bridge Road. Architect, Mr. T. A. Crawford, 80 Borough Road, Middlesbrough.

Sunderland. Willowcrete Manufacturing Company Limited. The contract for the erection of an office block in Back Deptford Terrace has been let to Middleton and Company, (Blackpool) Limited, Sunniside Chambers, West Sunniside, Sunderland.

Earnshaw Brothers Limited. Considerable bakery additions are proposed in Cooper Street. The architects are Newrick and Blackbell, 58 John Street, Sunderland.

Tynemouth. Holland, Hannen and Cubitts Limited, building and civil engineering contractors, Tyne View Terrace, Wallsend, are to erect transport depot, workshop and storage accommodation at Norham Road, North Shields.

J. Hogg and Son, Thrift Street, North Shields are to erect a plumbers' workshop to plans by G. H. Gray and Partner, Camden Street, North Shields.

Electricals Limited, 14 Claremont Place, Newcastle upon Tyne are in touch with the local authority regarding a suitable site for offices and other facilities.

Washington (Co. Durham). Harbour and General Works civil engineering contractors Limited, Howdon-on-Tyne and London, are to erect area offices and depot at Springwell.

Accrington. Burco-Dean & Co. Limited, 212 Shaftesbury Avenue, London WC. Extensions are to be made to the factory in Church Street.

Basingstoke. E. Pollard & Co. Limited, Brook Street, are to erect a new factory at Daneshill.

Bedford. Texas Instruments Limited, Dallas Road. The consulting engineers for the new factory are Oscar Faber & Partners, Torrington House, Holywell Hill, St. Albans.

Blackburn. British Tufted Machinery Limited, Extensions are to be made to the factory at Whitebirk.

Bootle. Stewart Thomson & Son, (Liverpool) Limited. New factory to be built in Leckwith Road.

The English Electric Company Limited are to extend their factory at Dunnings Bridge Road, Netherton.

New Factories

Burnley. The Dioana Cowpe Organisation is to convert Oak Bank Mill into a modern super factory.

The Northern Diecasting Company Limited, Norcastal Works are to make extensions to their works.

Burton Latimer. Alumasc Limited. The works are to be extended.

Chesterfield. Dema Glass Company Limited, Lockford Lane. Further extensions to the works.

Crawley. Corocraft Limited, 1 Argyle Street, London W1. A new factory is to be erected on the industrial estate.

Dagenham. Fletcher Brock & Collis Limited, Fowler Road, Ilford. Extensions to factory.

Dublin. Roux International Limited. A new factory is to be built at Harmonstown Road, Raheny. The architect is Brendon J. Collins, 5 Fitzwilliam Place.

Egham. Wescot Overall Manufacturing Company Limited. Factory extensions.

Glasgow. The Mine Safety Appliances Company Limited, Queenslie industrial estate are to make extensions to their factory.

Hastings. Elva Engineering Company Limited. A new factory is to be built in Sedlescombe Road North.

Hereford. H. Wiggins & Co. Limited. Works extensions.

Horsham. Avery-Hardoll Limited, Hayes Lane, Slinfold are to make extensions to their factory.

Horwich. J. W. Roberts Limited. A new factory is to be built in Chorley New Road, Lostock.

Hull. Electro Furnaces Products Limited. Contract for the erection of a new factory at Saltend awarded to A. Monk & Co. Limited, Padgate, Warrington.

Leeds. Andrews & Platt (Engineers) Limited, have applied for permission to erect a new factory at Elland Road.

London. Avo Limited, machine tool manufacturers. Extensions are to be made to the works in Douglas Street, London, SW1.

Macclesfield. The Chemical Equipment Engineering Company, are to erect a new factory on the Hurdsfield industrial estate.

Norwich. Roneo Limited, Hornchurch Road, Romford. The architects for the new factory at Salhouse Road, Sprowston are Alan W. Pipe & Sons, 8 Queen Street, London EC4.

Portsmouth. J. Cockerill & Son, 67-69 Commercial Road. A new factory and offices are to be built at Middle Street and West Street.

British La Bour Pump Company Limited, Blundell Street, London N7, are to erect a new factory at Downley Road, Leigh Park.

Redditch. The Birmingham Tempered Spring & Presswork Company Limited, 101 Irving Street, Birmingham. New factory.

Rotherham. Rother Boiler Company Limited. Extensions are to be made to the works at Meadow Bank Road.

Robert Jenkins & Co. Limited, Wortley Road are to make extensions to their works in North Greave Road.

Redruth. John Heathcoat & Co. Limited, Carn Brea. Contract for factory extensions awarded to Cowlin & Son, Limited, Stratton Street, Bristol.

Sheffield. C. & J. Hampton Limited, Bernard Road are to erect a new factory.

Southend. Industrial Press Limited, Bournemouth Park Road. The architects for the new factory are K. Wakeford, Jerram & Harris, 7 Connaught Place, London W2.

Stratford-on-Avon. Tappex Thread Inserts Limited, 46 High Street, Warwick, are to erect a new factory in Masons Road.

Stretford. Knightsbridge Cake (Manchester) Limited, Trafford Park. Extensions are to be made to the works in Brixham Road.

Swansea. Dan Hanson Limited, 280 Neath Road, Landore. A new factory is to be built at Kingsway trading estate.

Thetford. G. Williams Engineering Company Limited, Disraeli Road, Willesden, London NW10. New factory.

West Bromwich. Invincible Spring Company Limited, New Cross Street, Tipton. Contracts for the new factory are Altridge & Allen, 86 Cheshire Road, Smethwick.

Whitehaven. Smith Brothers (Whitehaven) Limited. Plans have been approved for extensions to the factory at North Shore.

Glasgow. James Bowen and Sons Limited, engineers and contracting equipment dealers. New workshops at 426 Helen Street.

Kid-Knit Manufacturing Company. Extension to clothing factory at 28/30 Charlotte Street, C1.

C. Sprenger and Sons Limited. Extensions to boxmaking factory at 35 Buccleuch Street.

Lime-Sand Mortar Limited, Knaresborough, Yorks, ready mix concrete depot at Firpark Street.

Carnald Engineering Company Limited. Extensions to workshop at Barfillan Drive.

East Kilbride. New factory premises are to be built in the new town of East Kilbride for the following: Imperial Chemical Industries—paint store; B.B.C. TV Outside Broadcast Unit—depot; Cincinnati Shaper Company Limited, to employ over 1400 people; J. H. Carruthers & Co. Limited—extension to Laird Portch (Fashions) Limited, which will eventually double their premises; and a nest of ten small factory units.

Messrs. Carruthers plan to transfer the entire production from three light engineering factories in Glasgow to East Kilbride, where they will ultimately employ about 380 men and women. Full production is anticipated by next year.

CLASSIFIED ADVERTISEMENTS

Business Opportunities

A press shop or light engineering works proprietor or manager who requires work or capital could, with advantage, study this announcement.

In our group, which has world wide connections and a diversity of interests, there is room for a business which can, after any necessary re-equipping, take on quantity production of small precision pressings in difficult metals. Given the services of forward looking personnel skilled in press tool design, maintenance and operation and with adequate technical and metallurgical background, capital would present no problem. Moreover, this side of the business is assured of a substantial nucleus of orders covering deep drawn components of new products for which a rapidly expanding market is already established. Initially, then, we require the services of a leader, not too far removed from the shop floor, who can, with our support, build up this unit as a major specialist supplier of the small press parts which others find it impossible or uneconomical to produce. Our plans are sufficiently flexible for us to start from scratch or to help the right man to build on to an existing business in which he already has an interest.

Even a highly skilled man well versed in the behaviour of the newer metals and alloys is likely to need all his ingenuity for many jobs which will come the way of this new organisation. Because this is a new venture we are using an accommodation address but those in whom the challenge awakens a response and who have the will to keep abreast of developments coupled with a dogged determination to see the job through should send full details to The Chairman, Box CW11, "Mechanical World", 31, King Street West, Manchester 3.

Situations Vacant

UNIVERSITY OF CANTERBURY
Christchurch :: New Zealand

LECTURER IN MECHANICAL ENGINEERING

APPLICATIONS are invited for the above position. Applicants must possess a degree in mechanical engineering of a recognised Commonwealth University preferably at Honours standard or an equivalent qualification; experience of modern drawing office practice would be desirable.

The salary attached to the position will be at the rate of £1025 per annum rising by annual increments of £50 to £1275 per annum. An allowance is made towards travelling expenses.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1.

The closing date for the receipt of applications, in New Zealand and London, is **30th November, 1958.**

AUSTRALIA—UNIVERSITY OF ADELAIDE

LECTURER IN MECHANICAL ENGINEERING

APPLICATIONS are invited for the above appointment; applicants should preferably have Drawing and Design experience.

Salary scale: £A1420—90—2050; with superannuation on the F.S.S.U. basis.

Copies of the general conditions of appointment of sub-professorial staff in the University of Adelaide and of a statement for the information of candidates may be had on application to the Secretary, Association of Universities of the British Commonwealth, 36 Gordon Square, London, W.C.1., or to the Registrar. Any further information desired will be supplied on request.

Applications, in duplicate, and giving the information listed in the general conditions of appointment, should reach the Registrar, University of Adelaide, Adelaide, South Australia, not later than **November 30, 1958.**

UNIVERSITY OF WESTERN AUSTRALIA

SENIOR LECTURESHIP OR LECTURESHIP IN MECHANICAL ENGINEERING

APPLICATIONS are invited for the above-mentioned position. The status of the appointee will depend on qualifications, age and experience. Preference will be given to those applicants with some experience and interest in—

(i) Industrial Management, Workshop Practice, and related topics.
(ii) Metallurgy, and Engineering Materials (properties and handling).

Conditions of appointment and general information are obtainable from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London W.C.1.

Applications close, in Australia and London, on **29th November, 1958.**

Miscellaneous

IMMEDIATE drawing office and workshops capacity available for plant design and prototyping of special purpose machinery. Write Sondes Place Research Institute, Dorking, Surrey.

Machinery, Plant and Accessories For Sale

PLASTIC Patterns, and Coreboxes reinforced with Fibre-glass, strong, durable, light and accurate. Made to specification, or from customer's wood patterns. Robert R. Shaw, Falkirk Pattern Works, Larbert, Scotland. Phone Larbert 300.

FOR SALE 10 Heat Exchangers, Makers Holden & Brooke, horizontal type. Overall dimensions 12" 6' × 4' dia., Shell and Covers welded construction. Capacity 810 galls per minute. Water from 110°F to 90°F, suitable for working pressure of 100 lb per sq in. Each contains nest of 1280 Steel Tubes 8' long ¾" o.d. and 16 swg. Recently left off working. Apply: Thos. Jenkins & Son Ltd. Exchange Buildings, Port Talbot.

18FT. × ¼ in. RHODES PRESS BRAKE for sale (or 10 ft × $\frac{1}{16}$"). 150 tons capacity. Motorised 400/3/50. Friction clutch. Motor adjustment to ram. 90° forming tool 10 ft 2 in. long, and bottom die with 1¼ in. openings. Bed and top beam solid steel, 18 ft. 1 in. long. Between uprights 10 ft 2 in. Stroke 5 in. die space 12 in. Weight about 20 tons. F. J. Edwards Limited, 359, Euston Road, London, NW1. or 41, Water Street, Birmingham 3.

NEW ALL STEEL MOTORISED PRESS BRAKE for sale, ex stock. Precision high speed undercrank type machine, with hand and treadle operated positive clutch; complete with vee top tool and universal die. Hand screw aligning mechanism to bottom die. Maximum pressure 20 tons. Forming capacity 63" × ⅛" with minimum flange of 1¾". Arranged for motor drive. Full details from F. J. Edwards Ltd., 359, Euston Road, London NW1.

"FRIGIDAIRE" Low Temperature Refrigerators. 49 in.w × 28 in.d × 34 in.h ext. Ex Large National User, suitable A.C. or D.C. Deep Freezing, Storage of Ice Cream, Frozen Foods, etc. Price £40.0.0 each. Domestic Refrigerators, Service Cabinets and Cold Rooms also available. A.R.C., 134 Great Portland Street, London W1. MUSeum 4480.

FANS! ! ! for Dust, fume extraction, air conditioning, compressors, accessories, motors, etc.; at considerably reduced prices. People say—"If only we'd known of you before. . . . Write for very interesting list. Bellangers, 306 Holloway Road, London N7. North 4117.

PUMPS for all purposes. R. L. Christansen Limited, Wordesley, Stourbridge. Brierley Hill 78184/5.

Patents for Sale or License

THE proprietor of British Patent No. 7523-58, relating to an improved method of goods storage in stillages, giving up to 20% increase in capacity, offers same for sale or license to British Manufacturer. Replies to: R. H. Stretton, Taurus Engineers, Bewdley, Worcs.

THE proprietors of British Patent No. 703867 is prepared to license British manufacturers to work thereunder. It relates to "Platform Devices" Address: Boult, Wade & Tennant, 112 Hatton Garden, London, EC1.

THE proprietor of British Patent No. 732322, entitled "Jogging Machine", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 637940, entitled "Tube Coupling Sleeve", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 East Jackson Boulevard, Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 603659, entitled "Power-lift Attachment for Tractors", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 East Jackson Boulevard, Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 590328, entitled "Timing Control For Mechanisms", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 East Jackson Boulevard, Chicago 4, Illinois, U.S.A.